Draft

Environmental Impact Statement for the Gas Hills In-Situ Recovery Uranium Project

November 2012

BLM

Lander Field Office, Wind River/Bighorn Basin District, Wyoming

BLM Mission Statement

The BLM's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

BLM/WY/PL-13/003+1020

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Wind River/Bighorn Basin District
Lander Field Office
1335 Main Street
Lander, Wyoming 82520

IN REPLY
REFER TO:

WYW140590
3809 (WYR05)

Dear Public Land User:

The Draft Environmental Impact Statement (EIS) for the Gas Hills In-situ Recovery (ISR) Uranium Project is hereby submitted for your review and comment. This EIS was prepared to analyze the potential impacts of a Plan of Operations submitted by Cameco Resources (also known as Power Resources Inc., a wholly owned subsidiary of Cameco US Holdings, Inc) to develop valid existing mining claims. The Gas Hills Project Area (GHPA) is located near the geographic center of Wyoming and encompasses approximately 8,500 acres within the Gas Hills Mining District.

This Draft EIS analyzes three alternatives in detail: the No Action Alternative, the Proposed Action Alternative and a Resource Protection Alternative. The Draft EIS also contains a discussion of other alternatives that were considered but eliminated from detailed analysis. Under the Proposed Action, Cameco proposes the development of uranium deposits in the GHPA through implementation of the ISR process, which involves recovery of uranium from the subsurface through chemical dissolution using wells constructed in a manner similar to conventional water wells. The process requires installation of surface infrastructure (processing facilities, waste water disposal facilities, roads, header houses, and power lines) as well as subsurface infrastructure (wells, pipelines, electrical lines and communication cables). Maximum new surface disturbance under the Proposed Action would be approximately 1,315 acres, or 15% of the GHPA.

The Resource Protection Alternative (RPA) would be similar to the Proposed Action in that it would involve ISR development of uranium deposits in the GHPA; however, the RPA would include several added features to reduce surface disturbance as well as increase and enhance reclamation success for the Project. Maximum surface disturbance under the RPA would be approximately 783 acres, or 7% of the GHPA. Under the BLM's draft guidelines for implementation of the 3809 regulations under FLPMA, a separate alternative consisting of the Proposed Action with additional mitigation to prevent unnecessary or undue degradation is analyzed under National Environmental Policy Act (NEPA). The RPA constitutes such a separate alternative for this project. The BLM could identify this separate alternative as the preferred alternative. Since the BLM has not determined whether the Proposed Action would cause unnecessary or undue degradation, a preferred alternative is not being identified in this EIS. A preferred alternative will be identified in the Final EIS after the BLM has considered comments on this Draft EIS.

The Draft EIS was prepared pursuant to NEPA, as well as other regulations and statutes, to address possible environmental and socio-economic impacts that could result from implementation of the project. This Draft EIS is not a decision document. Its purpose is to inform the public and the Decision Maker of the impacts associated with implementing the proponent's Plan of Operations, to evaluate alternatives to the proposal, and to solicit other agencies and the public for comments.

If you wish to submit comments on this Draft EIS, we request that you make them as specific as possible, with references to page numbers and chapters of the document. The most useful comments will contain new technical or scientific information, identify data gaps in the impact analysis, or provide technical or scientific rationale for opinions or preferences. Please refer to "Gas Hills ISR Project Comments" in your correspondence. Written comments will be accepted by fax, email, or letter for 45 days following the publication of the Notice of Availability in the Federal Register by the U.S. Environmental Protection Agency. Please provide your comments to:

Bureau of Land Management
Attn: Kristin Yannone
1335 Main Street
Lander, WY 82520-0589
Fax: 307-332-8444
Gas_Hills_Uranium_EIS_WY@BLM.gov

Copies of the Draft EIS are available for review at the BLM Lander Field Office at the above address or at the following website:

http://www.blm.gov/wy/st/en/info/NEPA/documents/lfo/gashills.html

Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you may ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. BLM will not consider anonymous comments. Comments, including names and street addresses of respondents, will be available for public review at the BLM Lander Field Office from 7:45 a.m. to 4:30 p.m. Monday through Friday, excluding federal holidays. Comments may be published as part of the NEPA document and other related documents. All submissions from organizations or businesses will be made available for public inspection in their entirety. For further information concerning the document, please contact Kristin Yannone at (307) 332-8400.

Sincerely,

Richard Vander Voet

Richard Vander Voet
Field Manager
Lander Field Office

Gas Hills In-situ Recovery Uranium Project
DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Project Name:	Gas Hills In-Situ Recovery Uranium Project Draft Environmental Impact Statement
Lead Agency:	U.S. Department of the Interior Bureau of Land Management Lander Field Office Wind River/Bighorn Basin District, Wyoming
Project Location:	Fremont and Natrona Counties, Wyoming
Correspondence on this EIS	Bureau of Land Management Lander Field Office Attn: Kristin Yannone 1335 Main Street Lander, WY 82520 Fax: 307-332-8444 Email: Gas_Hills_Uranium_EIS_WY@blm.gov
Date by which Comments Must be Postmarked to BLM:	Within 45 days of the date of the Notice of Availability published in the Federal Register

ABSTRACT

Power Resouces Inc., a wholly owned subsidiary of Cameco US Holdings Inc., doing business as Cameco Resources (Cameco) proposes to extract uranium from existing mining claims within the 8,500 acre Gas Hills Project Area (GHPA) located in eastern Fremont and western Natrona Counties, Wyoming. Cameco's proposed Gas Hills In-Situ Recovery Uranium Project (Project) would use in-situ recovery (ISR) methods to remove uranium from the subsurface through chemical dissolution using a series of wells similar to water wells. The Project would be located within the Gas Hills Mining District, an area of historic mining dating back to the early 1950s, and would include the following phases; infrastructure development, mine unit construction, mine unit operation, aquifer restoration, and final Project reclamation and decommissioning. Five mine units, constructed sequentially, are proposed for the Project, and would disturb approximately 1,315 acres during construction, 633 of which would remain disturbed during mine unit operation. After completion of uranium production all Project facilities would be decommissioned and all surface disturbance would be reclaimed by the end of the estimated 25 year life of the Project.

Three alternatives were analyzed in detail in this Draft EIS. They are: the No Action Alternative, the Proposed Action Alternative, and the Resource Protection Alternative. Under the No Action Alternative, the BLM would not approve Cameco's Project and none of the proposed uranium mining or associated activities would occur within the GHPA. Cameco would be responsible for the removal and reclamation of the existing Carol Shop facility and a portion of the existing roads within the GHPA. Exploration drilling would continue under the No Action Alternative. The Proposed Action Alternative would consist of Cameco's proposed Project for development within the GHPA. The Resource Protection Alternative would consist of Cameco's proposed Project with modifications to reduce the environmental impact of the Project. In addition to Cameco's commitment to voluntarily apply the applicant-committed environmental protection measures listed in this document, mitigation is recommended by the BLM that would lessen the environmental effects of the Project.

Written comments on the Draft EIS will be accepted by the Lander Field Office of the BLM throughout a 45-day public comment period beginning on the date the United States Environmental Protection Agency publishes a Notice of Availability for this EIS. A summary of the comments on this document and responses to the comments will be provided in the Final EIS.

Responsible Official for Draft EIS:	Richard Vander Voet

Executive Summary

Power Resources Inc. (PRI), a wholly owned subsidiary of Cameco US Holdings, Inc. doing business as Cameco Resources (Cameco) in the State of Wyoming, submitted a Plan of Operations (PoO) to the Bureau of Land Management (BLM) Lander Field Office (FO) for the proposed Gas Hills In-situ Recovery (ISR) Uranium Project (Gas Hills Project or Project) in central Wyoming. The Gas Hills Project is located near the geographical center of Wyoming within the Gas Hills Mining District, an area of historic uranium mining development which dates back to the 1950s (See **Figure 1-1**). Since the 1980s, activity in the Gas Hills Mining District has primarily been associated with mine and mill reclamation as well as ongoing uranium exploration. The Gas Hills Project would be operated as a satellite facility to Cameco's existing Smith Ranch-Highland Facility located in Converse County, Wyoming.

The Gas Hills Project Area (GHPA) is defined as the area encompassed by the mine permit boundary which covers approximately 8,500 acres (approximately 13 square miles). While the GHPA contains federal surface and mineral estate under the jurisdiction of both the BLM Lander and BLM Casper FOs, the Lander FO is serving as the lead office for coordinating the environmental analysis. The Project is permitted by the Wyoming Department of Environmental Quality (WDEQ) Land Quality Division (LQD) under Permit to Mine No. 687, and is licensed by the United States (U.S.) Nuclear Regulatory Commission (NRC) under Source Materials License SUA-1548.

Purpose and Need

The purpose of the BLM action related to the Gas Hills Project is to respond to Cameco's request for approval of the PoO to extract uranium from valid existing mining claims initially staked during the 1950s under the General Mining Law of 1872 and since acquired and consolidated by Cameco.

The need for the BLM action is established by BLM's responsibility under the laws and regulations regarding the availability of all locatable minerals on federal lands, including uranium, as specified under the General Mining Law of 1872 as amended (30 U.S. Code [USC] §§ 22-54 and §§ 611-615), the original public land authority in 43 USC, §§ 2, 15, 1201, and 1457, Title 43 of the Code of Federal Regulations (CFR) in Groups 3700 and 3800, and the Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC 1701 et seq.). Under these laws, the BLM has the obligation to allow and encourage claim holders to develop their claims, subject to restrictions to ensure this development will not cause undue or unnecessary degradation of public lands.

Scoping

The BLM conducted public and internal scoping to solicit input and identify environmental issues and concerns associated with the proposed project. The public scoping process was initiated on September 7, 2010, with the publication of a Notice of Intent (NOI) in the Federal Register. The BLM conducted scoping meetings in Casper, Riverton, Lander, and Jeffrey City using an open house format.

The BLM received a total of 21 comment submittals (e.g., letter or comment form) containing 215 individual comments during the public scoping period. Information gained during scoping assisted the BLM in identifying the potential environmental issues, alternatives, and mitigation measures associated with development of the Project. The process also provided a mechanism for narrowing the scope of issues so that analysis in the Environmental Impact Statement (EIS) could be focused on areas of high interest and concern. A majority of the comments were related to cumulative impacts, mitigation and monitoring, and potential impacts to range resources, water resources, and wildlife resources. There were also concerns and questions about the National Environmental Policy Act (NEPA) process and requests for additional public participation. The scoping period was closed on December 15, 2010.

The BLM conducted internal scoping to compile a list of resources potentially present in the Lander FO area to be considered in this EIS. Based on this list and public scoping, the following resources are discussed and analyzed in Chapters 3.0, 4.0, and 5.0 of this document:

- Air Quality;
- Cultural Resources and Native American Concerns;
- Geology;
- Land Use;
- Livestock Grazing;
- Paleontological Resources;
- Public Health and Safety;
- Recreation;
- Socioeconomics and Environmental Justice;
- Soils;
- Transportation;
- Vegetation Resources;
- Visual Resources;
- Water Resources;
- Wild Horses; and
- Wildlife and Fisheries Resources.

The BLM has determined that the proposed project is in conformance with the BLM management plans and policies and is consistent with other federal and local land management plans and policies. As allowed under 36 CFR 800.8, the BLM has used the public comment process under NEPA to comply with the public consultation requirements of Section 106 of the National Historic Preservation Act (NHPA).

Proposed Action and Alternatives

Chapter 2.0 of this EIS describes the GHPA boundaries, the existing and historic disturbances associated with uranium extraction present within the GHPA, and the proposed development alternatives, including a No Action Alternative, that are analyzed in this document. In developing the alternatives, the BLM followed guidance set forth in the BLM NEPA Handbook (H-1790-1), which provides for the development of a range of reasonable alternatives. Based on this guidance, the BLM developed the alternatives for analysis in this EIS described in the following paragraphs.

Approximately 1,300 acres, or 15 percent of the 8,500 acres within the permit boundary, has previously been disturbed by mining activities, primarily for uranium using surface mining methods, from the 1950s through the 1980s. Reclamation has led to the re-establishment of vegetation on about 900 acres of the lands previously mined. Existing infrastructure consists of roads, utilities, and structures resulting in approximately 131 acres of disturbance. The existing Carol Shop facility, a large, multi-bay building that was used as a maintenance shop for historic uranium mining activities, would be re-used by Cameco for the proposed development. In addition, the existing gas service and overhead power lines to the GHPA would be used for future development.

No Action: Under the No Action Alternative, the proposed uranium ISR project and associated activities would not occur within the GHPA. Under this alternative, the Carol Shop facility would be removed and

approximately 26.7 acres of disturbance would be reclaimed. If no other need for access roads were determined, 1.8 miles of road would be removed and approximately 10.9 acres (based on the current 50-foot disturbance width) would be reclaimed. Topsoil stored on approximately 2.6 acres would be redistributed on reclaimed areas. Exploration-related activities on BLM-managed lands would result in no more than 5 acres of unreclaimed surface disturbance at any time during the life of the NOI filed for each action under the 43 CFR 3809 surface management regulations. Reclamation of these sites would be anticipated to occur within the same calendar year as the disturbance. Under this alternative, a total of approximately 40.2 acres (less than 1 percent) within the GHPA would be reclaimed.

Analysis of the No Action Alternative is required under NEPA (43 CFR Section 1502.14[d]). The No Action Alternative may be selected by the BLM if the agency disapproves Cameco's PoO because the Project would cause undue or unnecessary degradation to resources managed by the agency (43 CFR, Section 3809.411[d][3][iii]).

Proposed Action: Cameco proposes the development of uranium deposits in the GHPA through implementation of the ISR process, which involves recovery of uranium from the subsurface through chemical dissolution using wells constructed similarly to conventional water wells. The process requires installation of surface infrastructure (processing facilities, waste water disposal facilities, roads, header houses, and power lines) as well as subsurface infrastructure (wells, pipelines, electrical lines, and communication cables). Activities associated with the Proposed Action would occur throughout the projected 25-year span of the Project, and would include the following phases:

1. **Infrastructure Development** – Construction or improvement activities occurring within the GHPA, but outside of mine units, including: upgrades to project infrastructure within the GHPA (roads, electrical lines, water disposal, and pipelines); and construction or upgrades to processing facilities.
2. **Mine Unit Construction** – Construction activities occurring within mine units, including: delineation drilling; installation of injection, production and monitoring wells, pipelines, booster pump stations, header houses, and roads to header houses.
3. **Mine Unit Operation** – Operation of the ISR process to remove and process uranium; interim reclamation of the majority of the mine unit construction disturbance.
4. **Mine Unit Restoration and Reclamation** – Restoration of groundwater and decommissioning and removal of mine unit infrastructure, and final surface reclamation within each mine unit.
5. **Final Project Reclamation and Decommissioning** – Decommissioning and reclamation of surface and subsurface infrastructures within the GHPA but outside of the mine units, such as evaporation ponds, roads and satellite facilities.

Each of the five mine units to be developed under the Proposed Action would be completely disturbed during construction activities, although it is possible that small patches of vegetation may be left intact. Surface disturbance would be reduced during mine unit operations due to interim reclamation of construction disturbance. The five mine units would be sequentially developed over the first 15 years of the Project life. The surface disturbance associated with facilities within the GHPA outside of mine unit boundaries, such as evaporation ponds, wastewater deep disposal wells, or mineral processing and water treatment facilities, would remain for the projected 25-year life of the Project. At the end of the Project, all of these facilities would be decommissioned or removed and disturbed areas would be reclaimed.

The total estimated construction disturbance for the Project is 1,315 acres, or approximately 15 percent of the GHPA. The surface disturbance for the Project during operations is estimated to be 633 acres, or approximately 7 percent of the GHPA.

Resource Protection Alternative: The Resource Protection Alternative (RPA), developed to respond to public and agency input, is similar to the Proposed Action in that it would involve the development of

uranium deposits in the GHPA through implementation of the ISR process. The RPA would utilize the same processes and take place over the same time period as the Proposed Action but with several added features designed to reduce surface disturbance; travel to and from the GHPA; and impacts to soils, vegetation, and wildlife; as well as increase and enhance reclamation of the Project:

- **Annual Development Planning:** Surface disturbance and potential for soil compaction and erosion associated with construction in each mine unit would be reduced and the potential for successful reclamation would be increased through submittal of an Annual Development Plan to the BLM that would require delineation of specific areas to be disturbed along with procedures to ensure that actual disturbance remains within planned areas.
- **Construction Timing Constraints:** The BLM would not allow construction of Mine Unit 3 until interim reclamation on Mine Unit 1 has been shown to make significant progress toward meeting reclamation success criteria. Likewise, construction of Mine Unit 4 would not begin until Mine Unit 2 interim reclamation is successful, and Mine Unit 5 construction would not begin until Mine Unit 3 interim reclamation has been demonstrated to be successful.
- **Closed Loop Drilling System:** Excavated drilling mud pits would be eliminated and replaced with closed loop systems for the management of drilling fluids.
- **Disturbance Offset for Additional Satellite Facility:** Disturbance associated with construction and operation of a second satellite facility would be offset through a requirement for reclamation of an equal area of existing unreclaimed or poorly reclaimed disturbance within the GHPA.
- **Reduced Number of Evaporation Ponds:** The number of evaporation ponds would be reduced during operations, assuming wastewater would be disposed of in deep injection wells.
- **Additional On-site Processing:** Additional on-site processing would produce yellowcake slurry, which would require fewer truck loads of resin to the Smith Ranch-Highland facility.
- **Enhanced Reclamation Goals and Timing:** Reclamation improvements would be realized through the use of rigorous reclamation goals and criteria, and by timely implementation of reclamation activities after completion of construction or operational activities.
- **Burial of New Power Lines:** Impacts to wildlife would be reduced by burial of all new power lines.

The total estimated construction disturbance for the RPA is 783 acres, or approximately 9 percent of the GHPA, which represents a 40 percent reduction in surface disturbance relative to the Proposed Action. The total estimated operational disturbance for the RPA is 282 acres (approximately 3 percent of the GHPA), a more than 50 percent reduction in disturbance relative to the Proposed Action.

Alternatives Considered but Eliminated from Detailed Analysis: The BLM considered five alternatives that were eliminated from detailed impact analysis in this EIS. Conventional mining, either open pit or underground methods, were not analyzed in detail because of a greater disturbance footprint and potential for impacts to groundwater, surface water, vegetation, soils, and wildlife relative to ISR methods. Seasonal operation of the ISR system was not further considered because the process cannot be shut down for short periods of time due to the need to maintain constant control of groundwater gradients. The BLM did not analyze an alternative that would prohibit a temporary closure of the facility as the agency determined that existing regulations made this alternative unnecessary. Alternate transportation routes to the Smith Ranch/Highland facility were not analyzed because the routes were not designed for frequent heavy vehicle use and are not maintained in winter. Finally, alternate waste disposal locations were not considered in the analysis because transportation of waste represents a small portion of Project-related traffic.

Affected Environment

Chapter 3.0 of the EIS describes the affected environment of the GHPA for each of the resources identified during internal scoping and listed above. These resources are present within the GHPA and

provide the basis to address substantive issues of concern brought forward during internal and public scoping. The information presented in Chapter 3.0 provides quantitative data and spatial information where appropriate to the resource that serves as a baseline for comparison of the direct, indirect, and cumulative impacts of each of the alternatives.

Environmental Consequences

Chapter 4.0 of the EIS describes the environmental effects of implementing the alternatives on the affected environment as described in Chapter 3.0. The chapter is divided into subsections addressing the specific incremental impacts for each of the resources identified during internal scoping listed above. The impact analysis for each resource was focused on the new disturbance over and above the existing disturbance in the GHPA associated with the No Action Alternative. For each of the action alternatives (Proposed Action and the RPA), the new disturbance is over and above the existing disturbance and the new disturbance associated with the No Action Alternative. The resource-specific effects of the alternatives are evaluated quantitatively and qualitatively, as appropriate, based on available data and the nature of the resource analyzed. A comparison of disturbance within the GHPA associated with the four alternatives is provided in **Table 2-4** of the Draft EIS. A summary of the Chapter 4.0 impact analyses is provided in **Table 2-5** of the Draft EIS.

Cumulative Impacts

Cumulative impacts from past, present, and reasonably foreseeable development are presented in Chapter 5.0 of the EIS. For each resource, the Cumulative Impact Study Area (CISA) was developed appropriate to the geographical extent of anticipated cumulative impacts. For some resources (e.g., cultural resources and Native American traditional values, geology, paleontology, soils, and vegetation), the CISA is the same as the GHPA. For other resources (e.g., socioeconomics and air quality), the CISA includes a larger area within which cumulative impacts could occur.

Projects considered in the cumulative impact analysis include the following:

- Past disturbance associated with historic uranium mining activities;
- Existing disturbance from ongoing projects associated with mineral exploration, mining, reclamation of historic mining activity under the Wyoming Abandoned Mine Lands program, oil and gas development, and long-term management of uranium tailings under the Department of Energy Legacy Management program; and
- Future disturbance from proposed project activities associated with Cameco's proposed ISR development, reclamation of historic mining activity under the Wyoming Abandoned Mine Lands program, and potential road construction and relocation by Fremont County.

The Proposed Action would represent approximately 70 percent of the cumulative surface disturbance within the GHPA associated with existing and reasonably foreseeable development. Similarly, the RPA would represent approximately 58 percent of the cumulative disturbance within the GHPA. The Proposed Action represents about 42 percent of the surface disturbance identified for all planned projects within the vicinity of the GHPA. In general, the cumulative impacts from past, present and reasonably foreseeable development are similar in character and magnitude to those for the proposed Project and alternatives.

List of Acronyms

°F	degree Fahrenheit
µg/m3	micrograms per cubic meter
ACEC	Areas of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ACM	Applicant-committed Measures
ADP	Annual Development Plan
AEA	Atomic Energy Act of 1954
AEC	Atomic Energy Commission
AIRFA	American Indian Religious Freedom Act of 1978
AML	abandoned mine lands
amsl	above mean sea level
AO	Authorized Officer
APE	Area of Potential Effect
APHIS	Animal and Plant Health Inspection Service
APLIC	Avian Power Line Interaction Committee
AQRV	Air Quality Related Values
ARPA	Archaeological Resources Protection Act
AUM	animal unit month
B.P.	before present
BEA	Bureau of Economic Analysis
bgs	below ground surface
BLM	Bureau of Land Management
BMP	Best Management Practice
BPT	Best Practicable Technology
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
Cameco	Power Resources Inc., Cameco US Holdings, Inc. (dba Cameco Resources)
CBNG	coal-bed natural gas
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CISA	Cumulative Impact Study Areas

CO	carbon monoxide
CO_2	carbon dioxide
CO_2^e	carbon dioxide equivalent
COMA	Comparison Area
CR	County Road
CWA	Clean Water Act
dB	decibel
dB(a)	decibels on an A-weighted scale
DDA	designated development area
DOE	Department of Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
ESD	ecological site descriptions
FLPMA	Federal Land Policy and Management Act
FO	Field Office
Gas Hills Project or Project	Gas Hills In-situ Recovery Uranium Mine Project
GHG	greenhouse gases
GHPA	Gas Hills Project Area
GIS	Geographic Information System
gpm	gallons per minute
GPS	Global Positioning System
HAP	hazardous air pollutant
HMA	Herd Management Area
HMMH	Harris, Miller, ;Miller, and Hanson
HUC	Hydrologic Unit Code
HWA	Hayden-Wing Associates
IM	Instruction Memorandum
IPCC	Intergovernmental Panel on Climate Change
IR	isolated resource
ISR	In-situ Recovery
km	kilometer
KOP	Key Observation Point
kV	Kilovolts

LM	Office of Legacy Management
LQD	Wyoming Department of Environmental Quality, Land Quality Division
LRP	Limited Reclamation Potential
LTA	Larsen-Tibesar Associates
LTSP	Long-term Surveillance Plan
Ma	million years ago
MBTA	Migratory Bird Treaty Act
mg/L	milligrams per liter
$miles^2$	square miles
MLRA	Major Land Resource Area
MOU	Memorandum of Understanding
mph	miles per hour
mrem	millirem
mrem/yr	millirem per year
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NOI	Notice of Intent
NO_X	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NSO	No Surface Occupancy
NWS	National Weather Service
O_3	ozone
OHV	off-highway vehicles
OSHA	Occupational Safety and Health Administration
P.L.	Public Law
PA	Programmatic Agreement
PAS	Pronghorn Archaeological Services
Pb	lead
pCi	picocuries
pCi/L	picocuries per liter

PFYC	Potential Fossil Yield Classification
PIF	Partners in Flight
PM	Particulate Matter
PM_{10}	Particulate Matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter of 2.5 microns or less
PoO	Plan of Operations
ppm	parts per million
PRB	Power River Basin
PRI	Power Resources Inc.
PRPA	Paleontological Resources Preservation Act of 2009
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
RFFA	reasonably foreseeable future actions
RMP	Resource Management Plan
RO	reverse osmosis
ROD	Record of Decision
ROW	right-of-way
RPA	Resource Protection Alternative
s.u.	standard unit
SARA	Superfund Amendment and Reauthorization Act
SCP	Spill Contingency Plan
SHEQ	Safety, Health, and Environmental Quality
SHPO	State Historic Preservation Office(r)
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_4	sulfuric acid
SPCCP	Spill Prevention Control and Countermeasure Plan
SRMA	Special Recreation Management Area
SSURGO	Soil Survey Geographic Database
SWPPP	Storm Water Pollution Prevention Plan
TCP	Traditional Cultural Properties
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TMP	Topsoil Management Plan
tpy	tons per year

TVA	Tennessee Valley Authority
U.S.	United States
U.S. NRC	United States Nuclear Regulatory Commission
UIC	Underground Injection Control
UMTRCA	Uranium Mill Tailings Radiation Control Act
UPZ	Uranium Point Zone
USACE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USDA-NRCS	United States Department of Agriculture-Nature Resource Conservation Service
USDOI	United States Department of the Interior
USDOT	United States Department of Transportation
USDW	Underground Sources of Drinking Water
USEPA	United States Environmental Protection Agency
USFS	United States Department of Agriculture, Forest Service
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
UW	University of Wyoming
VOC	volatile organic compounds
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standards
WCC	West Canyon Creek
WDA	Wyoming Department of Agriculture
WDEQ	Wyoming Department of Environmental Quality
WDEQ-AQD	Wyoming Department of Environmental Quality-Air Quality Division
WDEQ-LQD	Wyoming Department of Environmental Quality-Land Quality Division
WDEQ-WQD	Wyoming Department of Environmental Quality-Water Quality Division
WDR	Wyoming Department of Revenue
WDWS	Wyoming Department of Workforce Services
WEAD	Wyoming Economic Analysis Division
WGFD	Wyoming Game and Fish Department
WNv	West Nile Virus
WOGCC	Wyoming Oil and Gas Conservation Commission
WRCC	Western Region Climate Center
WRDS	Water Resources Data System

WSA	Wilderness Study Area
WSEO	Wyoming State Engineer's Office
WSGS	Wyoming State Geological Survey
WYDOT	Wyoming Department of Transportation
WYNDD	Wyoming Natural Diversity Database

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1.0 Introduction and Background

1.1 Project Location and Background

Power Resources Inc. (PRI), a wholly owned subsidiary of Cameco US Holdings Inc., doing business as Cameco Resources (Cameco) in the State of Wyoming, submitted a Plan of Operations (PoO) to the Bureau of Land Management (BLM) Lander Field Office (FO) for the proposed Gas Hills In-situ Recovery (ISR) Uranium Project (Gas Hills Project or Project) in central Wyoming. The Gas Hills Project is located in Townships (T) 32 and 33 North (N), Ranges (R) 89 and 90 West (W), 6th Principal Meridian, in an area of historic uranium mining development, the earliest of which dates back to the 1950s (**Figure 1-1**). Cameco is a publicly traded company in the business of mining, processing, and selling uranium-based products that are used for fuel in nuclear power facilities. The Gas Hills Project would be operated as a satellite facility to Cameco's existing Smith Ranch-Highland facility located in Converse County, Wyoming.

The Gas Hills Mining District is located near the geographical center of Wyoming, in eastern Fremont and Western Natrona counties approximately 45 road miles east of Riverton, Wyoming, and approximately 65 road miles west of Casper, Wyoming. Uranium was discovered in the Gas Hills Mining District in the early 1950s, and within a few years, thousands of claims were staked and many small open-pit mines were developed in shallow deposits above the water table. By the late 1950s, an ore mill had been constructed in Riverton for processing Gas Hills ore. Deposits below the groundwater table were discovered in the late 1950s, and large-scale surface and underground mining commenced. Production continued through the early 1980s, when a decline in uranium prices forced the closure of area mines and mills. Since then, activity in the Gas Hills Mining District has primarily been associated with mine and mill reclamation, as well as further uranium exploration.

The Gas Hills Project Area (GHPA) is defined by the mine permit boundary and covers approximately 8,500 surface acres (approximately 13 square miles). The GHPA includes mixed surface and mineral ownership as shown in **Table 1-1**. A small portion of lands within the GHPA (approximately 1 percent) are split estate, where the mineral estate is managed by the BLM but the surface is owned by the state or private individuals. While the GHPA contains federal surface and mineral estate under the jurisdiction of both the BLM Lander and the BLM Casper FOs, the Lander FO is serving as the lead office for coordinating the environmental analysis. The Project is permitted by the Wyoming Department of Environmental Quality (WDEQ)-Land Quality Division (LQD) under Permit to Mine No. 687, and is licensed by the United States (U.S.) Nuclear Regulatory Commission (U.S. NRC) under Source Materials License SUA-1548.

Table 1-1 Land Management or Ownership

Management or Ownership	Gas Hills Project Area			
	Surface		Mineral	
	Percent	Acres	Percent	Acres
Federal	94	7,977	94	8,038
State	2	164	6	480
Private	4	377		
Total	**100**	**8,518**	**100**	**8,518**

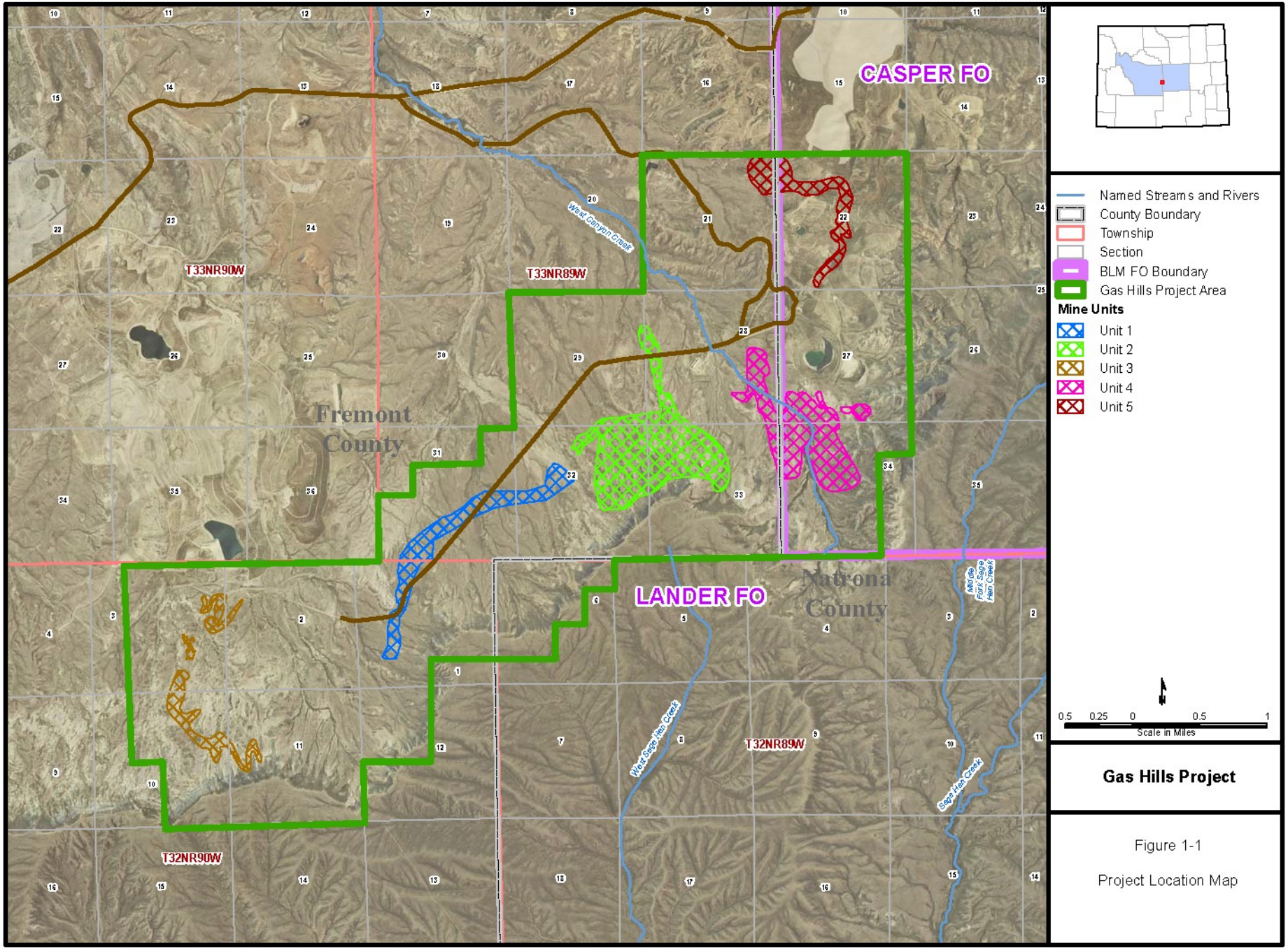


Figure 1-1

Project Location Map

1.2 Purpose and Need

National Environmental Policy Act of 1969 (NEPA) includes a requirement to present the purpose and need for the BLM action related to the Project. The purpose and need statement serves as the justification for agency action, as well as establishing the basis for developing a reasonable range of alternatives.

The purpose of the BLM action related to the Gas Hills Project is to respond to Cameco's request for approval of the PoO to extract uranium from valid existing mining claims initially staked during the 1950s under the General Mining Law of 1872 and since acquired and consolidated by Cameco.

The need for the BLM action is established by the BLM's responsibility under the laws and regulations regarding the availability of all locatable minerals on federal lands, including uranium, as specified under General Mining Law of 1872 as amended (30 U.S. Codes [USC] §§ 22-54 and §§ 611-615), the original public land authority in 43 USCs §§ 2, 15, 1201, and 1457, Title 43 of the Code of Federal Regulations (CFR) in Groups 3700 and 3800, and the Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC 1701 et seq.). Under these laws, the BLM has the obligation to allow and encourage claim holders to develop their claims, subject to restrictions to ensure this development will not cause undue or unnecessary degradation of public lands.

1.3 BLM Decisions to be Made

The decisions to be made by the BLM-Authorized Officer (AO) are whether to:

1. Approve Cameco's PoO and associated plans relating to ISR mining of uranium on public lands managed by the BLM;
2. Approve Cameco's PoO and associated plans relating to ISR mining on public lands managed by the BLM with changes or conditions to prevent undue or unnecessary degradation to public lands, and to meet standards of 43 CFR 3809.420; or
3. Disapprove Cameco's PoO and associated plans.

1.4 Legal and Policy Considerations

1.4.1 Mining Claims and History

Mining claims associated with the Gas Hills Project initially were staked by multiple small operators and companies during the 1950s. Most of the claims were consolidated under Federal American Partners in the 1970s through partnerships between the following companies; Gas Hills Uranium, Federal Resources, and Radorock Uranium. The Federal American Partners and Tennessee Valley Authority (TVA) joined a partnership in the 1970s, when both underground and open-pit mines were developed. The final consolidation occurred in the early 1980s when TVA obtained Western Nuclear's East Gas Hills properties. Cameco purchased the properties from TVA in multiple agreements between 1991 and 1996, and is currently the sole owner of the claims for the Gas Hills Project.

1.4.2 Conformance with Federal Management Plans and Policies

The BLM has the responsibility and authority to manage the publically held surface and subsurface resources located within the jurisdiction of the Lander and Casper FOs. The Lander FO has taken the lead role for the development of the Gas Hills Project Environmental Impact Statement (EIS), but the Project must conform with the Resource Management Plan (RMP) for each office.

Policies for development and land use decisions for federal lands and minerals for the Gas Hills Project are contained in the following federal documents:

- Record of Decision (ROD) and Approved Casper RMP (BLM 2007a);
- ROD for the Lander RMP (BLM 1987). All alternatives in this EIS were compared to both the existing management as described in the 1987 ROD, as well as to proposed management described under the alternatives in the Draft RMP and EIS for the Lander FO (BLM 2011b) to determine that this decision did not preclude the selection of the proposed RMP alternatives; and
- General Mining Law of 1872, as amended (30 USCs §§ 22-54 and §§ 611-615), as amended.

Additional guidance for the GHPA is contained in the following documents:

- Revised PoO, Gas Hills Uranium ISR Project (PRI 2011a);
- ADAMS Accession Numbers ML040070538 and ML040070311. Environmental Assessment for the Operation of the Gas Hills Project Satellite In-situ Leach Uranium Recovery Facility (Nuclear Regulatory Commission [U.S. NRC] 2004);
- U.S. Department of the Interior (USDOI)-BLM-WY-060-EA10-111 Environmental Assessment for Cameco Resources/Power Resources Incorporated Reynolds Ranch In-situ Uranium Recovery Project, Converse County, Wyoming (BLM 2011a);
- ADAMS Accession Number ML104330120. EIS for the Nichols Ranch ISR Project in Campbell and Johnson counties, Wyoming. Supplement to the Generic EIS for In-situ Leach Uranium Milling Facilities (U.S. NRC 2011a);
- 10 CFR Part 71 (U.S. NRC) and 49 CFR Part 173.389 (U.S. Department of Transportation [USDOT]). Transportation of radioactive material in accordance with U.S. NRC regulation, and transport of all byproduct material for offsite disposal in accordance with USDOT in addition to U.S. NRC regulations;
- Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development. Fourth Edition. BLM/WO/ST-06/021+3071/REV 07 (USDOI and USDA 2007);
- State of Wyoming Executive Order (EO) 2011-5 Greater Sage-Grouse Core Area Protection (Wyoming Office of the Governor 2011); and
- Title 42, U.S. Code, Section 7901 Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA).

Management objectives within the Lander RMP ROD and Casper RMP ROD include allowing locatable mineral exploration and development in the Gas Hills region, while protecting or mitigating impacts to other resource values. As such, the Gas Hills Project is consistent with the management decisions contained in the RMPs.

The U.S. NRC, established under the Energy Reorganization Act of 1974, Atomic Energy Act of 1954 (AEA), as amended by UMTRCA, is authorized to issue licenses for the possession and use of source material and byproduct material. These statutes require that U.S. NRC ensure source material, as defined in AEA Section 11(z) and byproduct material, as defined in AEA Section 11e(2) is managed to conform with applicable regulatory requirements. Uranium ISR is regulated by the U.S. NRC pursuant to the requirements of 10 CFR Part 40, “Domestic Licensing of Source Material,” and Cameco must obtain approval from U.S. NRC to conduct uranium recovery activities in the Gas Hills.

In 1998, Cameco, operating as PRI submitted an application to the U.S. NRC that requested an amendment to Source Material License SUA-1511 for the Highland Uranium Project which would allow the operation of a satellite ISR uranium recovery facility at the Gas Hills Project site. With the combination of the Smith Ranch-Highland facility, the previous request became a request to amend the newly combined Smith Ranch-Highland facility license (SUA-1548). In January, 2004, U.S. NRC

completed an Environmental Assessment (EA) of Cameco's request to amend license SUA-1548 (U.S. NRC 2004).

While the BLM was a cooperating agency in the development of the U.S. NRC EA, the environmental analysis did not address impacts to resources the BLM must consider to make a decision. In particular, surface disturbance was not addressed in sufficient detail for BLM's NEPA review purposes. Moreover, the U.S. NRC EA pre-dated the determination by the U.S. Fish and Wildlife Service (USFWS) that listing the greater sage-grouse as a threatened or endangered species was warranted but precluded by workload. The BLM policy directs that an EIS normally should be prepared for mining projects anticipated to result in surface disturbance greater than 640 acres. For these reasons, the BLM determined that the U.S. NRC EA did not provide the level of environmental analysis required to meet the BLM guidance for public lands, and further environmental analysis, including the development of an EIS, would be necessary.

1.4.3 Conformance with Local Land Management Plans and Policies

The State of Wyoming is a cooperating agency on this EIS. There are no comprehensive State of Wyoming plans for the GHPA. Through the Office of the Governor, protections associated with Project components that fall under the jurisdiction of individual state agencies have been identified and included in Project Alternatives discussed in this document.

The Project is located in both Fremont and Natrona counties. Fremont County has developed the Fremont County Wyoming Land Use Plan (Fremont County Natural Resources Planning Committee 2004), which is "intended to be a guide for the citizens of Fremont County in identifying and respecting the customs, culture, economic viability, social stability and quality of life found in this unique area, and then applying those values to growth and development as they occur in the county." The Fremont County plan recognizes the influence the mineral industry has on area values, and includes provisions for encouraging and supporting economically feasible mineral development. As a cooperating agency, Fremont County has been involved in the development of Project alternatives described in this document. Because the Gas Hills Project would both supply income from royalties and meet Fremont County concerns, the Proposed Action is consistent with Fremont County planning objectives.

Natrona County has developed the Natrona County Development Plan (Land Use Task Force et al. 1998), which includes discussion of the use and development of public lands within the County. The Natrona County plan emphasizes multiple use to provide encouragement for the traditional uses of ranching, agricultural, and mineral development in rural areas, as well as to encourage a balanced and sustainable multiple use of public lands and resources in Natrona County. The Proposed Action is consistent with the Natrona County Development Plan.

1.4.4 Authorizing Actions and Project Relationships to Statutes and Regulations

The BLM authority for land management is derived from the FLPMA. General BLM regulations are described in 43 CFR, Subtitle B – Regulations Relating to Public Lands, Chapter II – BLM, USDOI. The BLM regulations for the management of mining are included in 43 CFR Subpart 3809, Surface Management, and derive their mandate from Sections 302 and 303 of the FLPMA. Subpart 3809 establishes procedures and standards for mining claimants to prevent public land degradation and requires reclamation of disturbed areas. It also requires coordination with state agencies. Under 43 CFR 3809 surface management regulations, surface activity for the Project is more than casual use (includes use of mechanized equipment), and therefore requires a PoO, a full environmental assessment, and reclamation bonding.

The management of use and occupancy of public lands for the development of locatable minerals is described in the provisions of 43 CFR 3715. The BLM will make a determination as to whether or not the construction, presence, or maintenance of the temporary or permanent structures described in the PoO meet the requirements of the 43 CFR 3715 regulations.

The General Mining Law of 1872 declared all valuable mineral deposits in land belonging to the U.S. to be free and open to exploration and purchase. Under FLPMA, these actions require recordation of mining claims with the BLM and authorized regulations for surface protection of the public lands. The Mining and Mineral Policy Act of 1970 mandates that federal agencies ensure that closure and reclamation of mine operations be completed in an environmentally responsible manner. The Mining and Mineral Policy Act of 1970 states that the federal government should promote the "development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined lands, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining or mineral activities."

In Wyoming the BLM coordinates review of surface management PoO, bonding, and inspections with the WDEQ-LQD under a Memorandum of Understanding (MOU) established in 1975 and supplemented in 2003 (MOU No. WY 19). In accordance with the MOU, the bond amount is established by the WDEQ-LQD and the BLM reviews the bond for adequacy and responds with concurrence or recommendations for modification. Inspections are conducted jointly when possible and primary responsibility is given to the WDEQ-LQD for Regular and Small Mining Operations. Also, as part of the MOU the BLM and WDEQ-LQD agree that the operator shall be responsible for providing updated reclamation bond estimates annually. The current bond amount held for the project is equal to $3,473,800.00. The bond amount will be reviewed by the BLM in accordance with the provisions of 43 CFR 3809.552, and the BLM will periodically review the estimated cost of reclamation and require increased coverage if necessary.

Other major federal, state, and local regulations and permits that are relevant to the Proposed Action include, but are not limited to, those listed in **Table 1-2**.

Table 1-2 Major Federal and State Laws, Regulations, and Applicable Permits

Issuing Agency	Name and Nature of Permit/Approval	Regulatory Authority (if appropriate)
Federal Agencies		
BLM	BLM, as lead federal agency, to review, provide input, and approve the PoO, and issue a ROD.	NEPA (Public Law [P.L.] 91-190), Council on Environmental Quality (CEQ) – Regulations for Implementing NEPA (40 CFR Parts 1500-1508), and USDOI Implementation of NEPA; Final Rule (43 CFR Part 46).
	BLM to authorize ISR mining operations based on submitted PoO.	General Mining Law of 1872, as amended (30 USC §§ 22-54 and §§ 611-615), as amended, and implementing regulations (43 CFR Group 3700 and 3800).
		Portions of FLPMA 43 USC §§ 1701-1782, as amended that affect the General Mining Law.
	Antiquities and cultural resource permits on BLM-administered land.	Antiquities Act of 1906, as amended (16 USC 431-433). Archaeological Resources Protection Act (ARPA) of 1979, as amended (16 USC 470aa-47011). Preservation of American Antiquities, as amended (43 CFR 3). National Historic Preservation Act of 1966, as amended (NHPA) (16 USC 470) (36 CFR Part 80).

Table 1-2 Major Federal and State Laws, Regulations, and Applicable Permits

Issuing Agency	Name and Nature of Permit/Approval	Regulatory Authority (if appropriate)
BLM (Continued)	Evaluate Environmental Justice.	EO 12898, Environmental Justice. February 11, 1994.
	Pesticide Use Permit and Daily Pesticide Application Record.	BLM Authorization for Herbicide Applications on Federal Lands.
	Federal Noxious Weed Act compliance.	Plant Protection Act of 2000 (P.L. 106-224, 7 USC 7701); Federal Noxious Weed Act of 1974, as amended (USC 2801-2814); EO 13112 of February 3, 1999.
	Initiation of Section 7 consultation.	Section 7 of the Endangered Species Act of 1973, as amended (ESA) (16 USC et seq.).
	Paleontological Resource Use Permit; approval for surveys and potential data collection at well pads and road sites.	FLPMA (302[b]).
	Identify and comply with Native American Religious Concerns.	American Indian Religious Freedom Act of 1978 (AIRFA) (42 USC 1996).
U.S. NRC	U.S. NRC to grant Source Material License(s) and Radioactive By-Products Material License.	Requirements under Title 10 CFR Part 40 (Domestic Licensing of Source Material), and the guidance in U.S. NRC 1569, (Standard Review Plan for In-Situ Leach Uranium Extraction License Applications), and Title 10 CFR, Part 51 (Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions).
U.S. Environmental Protection Agency (USEPA)	Concurrence on Underground Injection Control wells through WDEQ-Water Quality Division (WQD).	Safe Drinking Water Act (33 USC §1251 et seq. (1972), Sections 1422 and 1425).
	Water quality exemption for the aquifer associated with the production zone with concurrence from WDEQ-LQD.	Aquifer Exemption (40 CFR Parts 144 and 146).
USFWS	Informal or formal consultation under Section 7; Coordination under Section 9.	ESA (P.L. 93-205).
	Protection of birds that live, reproduce, or migrate within or across international borders.	Migratory Bird Treaty Act (MBTA) of 1918, as amended; Bald and Golden Eagle Protection Act of 1940.
	Protection of bald and golden eagles.	Bald and Golden Eagle Protection Act of 1940, as amended (16 USC 668(a); 50 CFR 22).
State Agencies		
WDEQ-WQD	Permit for evaporation ponds[a]; permit for drinking water well.	WDEQ, Water Quality Rules and Regulations Chapter 3, Regulations for Permit to Construct, Install or Modify Public Water Supplies, Wastewater Facilities and Other Facilities Capable of Causing or Contributing to Pollution.

Table 1-2 Major Federal and State Laws, Regulations, and Applicable Permits

Issuing Agency	Name and Nature of Permit/Approval	Regulatory Authority (if appropriate)
WDEQ-WQD (continued)	National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges from Construction Activities.	WDEQ, Water Quality Rules and Regulations Chapter 2, Permit Regulations for Discharges to Wyoming Surface Waters.
	NPDES Industrial Storm Water Permit.	
	Groundwater Discharge Permit to a Class 1 injection wells (water disposal).	WDEQ, Water Quality Rules and Regulations Sections 8 and 13.
WDEQ-LQD	Concurrence with USEPA on an Aquifer Exemption for in-situ mining.	WDEQ, Chapter 11, Section 10 Land Quality Non-Coal Rules and Regulations.
	Noncoal Mine Environmental Protection Performance Standards.	WDEQ, Chapter 3, Land Quality Non-Coal Rules and Regulations.
	In-situ Permit to Mine (Class III injection wells for ISR operations).	WDEQ, Chapter 11, Land Quality Non-Coal Rules and Regulations.
WDEQ-Air Quality Division (AQD)	Air Quality Permit to Construct Air Quality Permit to Operate.	Wyoming Environmental Quality Act, Article 2, Air Quality, as amended (Wyoming Statutes 35-11-201 through 35-11-212).
	Prevention of Significant Deterioration (PSD) Program. National Emission Standards for Hazardous Pollutants Pre-Construction Approval.	Clean Air Act (CAA), as amended (42 USC 7401 et seq.).
Wyoming Game and Fish Department (WGFD)	Determine compliance through external review for greater sage-grouse core areas and management recommendations.	Wyoming EO 2011-05.
	Consult on mitigation measures as required, including protection of raptors from power lines.	In-Situ Mining Permit Application Requirements Handbook §35-11-103(e).
State Historic Preservation Office (SHPO)	Review and compliance activities related to cultural resources.	Consultation under Section 106, NHPA (36 CFR Part 80).
Wyoming Department of Transportation (WYDOT)	Permits for oversize, over length, and overweight loads.	Chapters 17 and 20 of the Wyoming Highway Department Rules and Regulations.
Local Agencies		
Fremont County Planning and Rural Addressing Department	Building permit for all new small wastewater (septic) systems that generate less than 2,000 gallons per day of sewage.	Fremont County Zoning and Building Codes

[a] Permitting and reporting requirements under USEPA 40 CFR 61 Subpart W, do not apply to evaporation ponds at ISR facilities.

1.5 Public Participation

1.5.1 Public Participation and Scoping Summary

The Notice of Intent (NOI) for the Gas Hills Uranium ISR Project was published in the *Federal Register* on September 7, 2010, and included a project description and the BLM contact information. In addition to the NOI, the BLM mailed 312 Dear Interested Party letters on October 18, 2010, notifying the public about the Project, the intent to prepare an EIS, and providing information about the scoping meetings. Display advertisements were placed in local newspapers (**Table 1-3**) providing information about the public scoping meeting dates, times, and locations.

Table 1-3 Newspaper Publications

Newspaper	Dates Published
Casper Star Tribune	10/24/2010
Riverton Daily Ranger	10/26/2010, 11/16/2010
Lander Journal	10/24/2010, 10/27/2010, 11/14/2010
Wind River News	10/21/2010, 11/11/2010

Additionally, the BLM issued press releases announcing the intent to prepare an EIS and information about the upcoming public scoping meetings. A press release was issued on September 8, 2010, announcing the BLM's intent to prepare an EIS; on October 13, 2010, announcing the public scoping meetings in Casper, Riverton, and Lander, Wyoming; and a final press release was issued on November 8, 2010, announcing an additional public scoping meeting in Jeffrey City, Wyoming.

Initially, the BLM hosted 3 public scoping meetings in Casper, Riverton, and Lander, Wyoming. At the request of Fremont County Commissioners, a 4th public scoping meeting was held in Jeffrey City, Wyoming. The date, times, location, and number of attendees at the scoping meetings are provided in **Table 1-4**.

Table 1-4 Scoping Meetings

Meeting Location	Meeting Date/Time	Number of Attendees that Signed In
Natrona County Public Library Casper, Wyoming	October 26, 2010 4:00 pm – 6:00 pm	32
Fremont County Library Riverton Branch Riverton, Wyoming	October 27, 2010 4:00 pm – 6:00 pm	38
Fremont County Library Lander Branch Lander, Wyoming	October 28, 2010 4:00 pm – 6:00 pm	28
Jeffrey City Fire House Jeffrey City, Wyoming	November 18, 2010 4:00 pm – 6:00 pm	16

The scoping meetings were conducted using an open house format. The informal open house format allows meeting attendees the opportunity to ask the BLM representatives, the Project applicant, and the NEPA contractor questions about the Project and the NEPA process. Display boards showing the NEPA

process and maps of the Project were provided to facilitate conversation. Fact sheets were distributed to meeting attendees describing the Project, the NEPA process, and how the public can be involved. Comment forms were available for the public to complete and submit to the BLM at the meeting, or for mailing to the BLM at a later date. The scoping period closed December 15, 2010.

More details on the public scoping process, meetings, and the comments submitted can be found in the "Gas Hills Uranium EIS Scoping Summary Report" dated February 2011, which was posted to the Project website hosted by the BLM (http://www.blm.gov/wy/st/en/info/NEPA/documents/lfo/gashills.html).

1.5.1.1 Primary Issues from Public Scoping

The BLM received a total of 21 comment submittals (e.g., letter or comment form) containing 215 individual comments during the public scoping period. Following the close of the public scoping period, comments were compiled and analyzed to identify issues and concerns. Each comment was identified, reviewed, and entered into an electronic database. As comments were entered, contact information for the commenter was added to or updated in the mailing list to ensure that all interested parties would receive information throughout the EIS process.

Information gained during scoping assisted the BLM in identifying the potential environmental issues, alternatives, and mitigation measures associated with development of the Project. The process provides a mechanism for narrowing the scope of issues so that analysis in the EIS can focus on areas of high interest and concern. A majority of the comments were related to cumulative impacts, mitigation and monitoring, and potential impacts to range resources, water resources, and wildlife resources. There were a number of concerns and questions about the NEPA process and requests for additional public participation. Some of the comments were assigned to more than one category, so they were counted more than once in the table of comments. The following list summarizes submitted concerns by topic category.

- *Alternatives.* Aspects of the Project that should be considered in discussions of alternatives include: phasing; reclamation, and restoration criteria and timing; transportation routes; and wastewater treatment, storage, and disposal.
- *Mitigation and Monitoring.* Previous mining activities in the area have contributed to unreclaimed or poorly reclaimed surface disturbance. Surface reclamation in the area could be problematic. Groundwater restoration could be difficult, and the EIS should examine potential groundwater restoration issues; the timing, inspection, and enforcement of reclamation or restoration needs better definition, and appropriate bonding needs to be required.
- *Rangeland Resources*. The EIS should disclose potential impacts to area recreation, including hunting. Current land use includes grazing, and the EIS should discuss both impacts of grazing to the existing vegetation and impacts to grazing and to grazing permit holders from the Project.
- *Water Resources*. Concerns included potential impacts to both surface water and groundwater. Potential impacts to surface waters to be addressed include river sedimentation from runoff and erosion, protection of existing reclaimed water bodies or impoundments, and the potential for selenium to become concentrated in evaporation ponds. Potential impacts to groundwater to be addressed include contamination of groundwater and aquifers and methods for maintaining the hydraulic cone of depression in case of a temporary shutdown (power interruption). The potential for drawdown due to the mining process to impact area streams and springs, including reducing flows and causing contamination through communication of mine water also should be addressed.
- *Wildlife Resources*. Changes in vegetation due to the Project could impact wildlife, including sage-grouse, mule deer, and antelope. Issues relating to proposed evaporation ponds such as exposure pathways to wildlife, including migratory birds, through drinking water exposure also are of concern. A full description of mitigation for impacts to wildlife should be included,

particularly for migratory birds. The Project needs to adhere to the MBTA. The potential for wildlife mortality due to Project-related traffic also should be analyzed.

- *NEPA Process and Public Participation*. The public desired assurance of a complete analysis of impacts. There were concerns that the length of the scoping comment period was insufficient and that information associated with the Project was not readily available (e.g., that Project documents were sufficiently available, whether the public had opportunity for site visits and to attend Cooperating Agency meetings).
- *Cumulative Impacts*. A description of any monitoring that will be incorporated or has been performed to determine area air quality should be included in the analysis description. Impact analysis should include a description of impacts from other uranium projects and non-mining projects in the region. Additionally, short- and long-term impacts to surface water and groundwater and impacts to livestock grazing due to multiple area projects should be discussed.

1.5.2 Agency Coordination and Consultation

1.5.2.1 Cooperating Agency Participation

The BLM identified state agencies, local governments, tribal governments, and other federal agencies with jurisdiction or special expertise for potentially impacted environmental resources associated with the Gas Hills Project. These agencies were extended the opportunity to become Cooperating Agencies for the development of this document and to be involved in the development of alternatives and mitigation measures presented within this document. Agencies were contacted in early December 2010 to determine their interest in participating as Cooperating Agencies. A list of those agencies and their status as Cooperating Agencies is included in **Table 1-5**.

Table 1-5 Agencies Invited to be Cooperators

Agency	Name of Contact	Date of Response	Cooperating Agency Status
U.S. NRCS	Casper Service Center	1/3/2011	Declined
Department of Energy (DOE)	Carol Borgstrom	-	Declined[a]
Fremont County Commission	Douglas L. Thompson	12/14/2010	Cooperating Agency
Natrona County Commission	Rob Hendry	-	Declined[a]
Natrona County Conservation District	Tom Walters	-	Declined[a]
Nuclear Regulatory Commission[b]	Alan Bjornsen	-	Declined[a]
U.S. Department of Agriculture (USDA) – Forest Service (USFS)	Ruth Esperance	-	Declined[a]
USEPA	James Hanley	12/3/2010	Cooperating Agency
USFWS	Alex Schubert	12/3/2010	Cooperating Agency
Office of the Wyoming Governor	Steve Furtney, Ryan Lance	12/27/2010	Cooperating Agency
USDA	Jason Fearneyhough, Michelle MacDonald	-	Cooperating Agency[c]
Department of Revenue, Ad Valoreum Tax	Ken Uhrich		

Table 1-5 Agencies Invited to be Cooperators

Agency	Name of Contact	Date of Response	Cooperating Agency Status
Office of State Lands and Investments	Susan Child	-	Cooperating Agency[c]
State Engineer's Office	Sue Lowry		
State Geological Survey	Alan Verploeg		
State Parks, Historic Sites, and Trails	Donimic Bravo		
State Planning Office	Melissa Hayes		
Travel and Tourism	Vicki Morris		
Water Development Commission	Phil Ogle		
Wyoming Business Council	Roger Bower		
WDEQ	Dan Clark		
WYDOT	Gregg Friedrick		
WGFD	Gwen Booth		
Wyoming Livestock Board	Jim Logan		
Wyoming Oil and Gas Conservation Commission	Thomas Doll, Gary Strong		
Wyoming State Forestry Division	Bill Crasper		

[a] No response to the BLM's invitation to become a Cooperating Agency was received; no response was interpreted as declining the invitation.

[b] The U.S. NRC previously completed an EA for the Gas Hills Project, and is a signatory on the 2003 Programmatic Agreement (PA) among the Wyoming SHPO, U.S. NRC, BLM, and PRI (dba Cameco), and has further signed the May 2012 PA Amendment making the BLM the lead federal agency for Section 106 consultation.

[c] The Office of the Wyoming Governor has accepted the role of Cooperating Agency; involvement of indicated state agencies as cooperating agencies is coordinated through that Office.

Note: Earlier communications with the National Park Service (NPS) indicated no parks would be affected by the Gas Hills Project; therefore, NPS has no jurisdiction and was not asked to become a cooperating agency.

Cooperating Agencies were consulted throughout the development of this EIS to ensure a comprehensive analysis was performed. Additionally, input on the document was requested from the Cooperating Agencies at specific points during the development of the document, as summarized in **Table 1-6**.

Table 1-6 Cooperating Agency Involvement

Input requested	Time Period	Format
Development of Action Alternatives for Project	November 2010 through May 2011	E-mail, telephone discussions, Alternative meeting held March 29
Review of Preliminary Draft EIS	April through May 2012	E-mail, telephone discussions

A meeting held on March 29, 2011 was open for public observation. Comments provided by members of the public during these meetings, either verbally or in writing, were used to inform the discussions of the Cooperating Agencies in developing the EIS.

1.5.2.2 Native American Consultation

Native American consultation was initiated on May 6, 2011, with notification of the BLM's intent to prepare an EIS for the Gas Hills Project to 14 tribes. A list of the tribes notified and which tribes responded are included in **Table 1-7**.

Table 1-7 Native American Consultation Summary

Tribe	Date(s) of Response
Ute Indian Tribe	no response to date
Northern Arapaho Tribe	no response to date
Eastern Shoshone Tribe	no response to date
Crow Nation	no response to date
Northern Cheyenne Tribe	no response to date
Shoshone-Bannock Tribe	no response to date
Rosebud Sioux Tribe	no response to date
Oglala Sioux Tribe	no response to date
Cheyenne River Sioux Tribe	no response to date
Lower Brule Sioux Tribe	no response to date
Fort Peck Assiniboine Sioux Tribes	no response to date
Standing Rock Sioux Tribe	response received by BLM
Crow Creek Sioux Tribe	no response to date
Yankton Sioux Tribe	no response to date

2.0 Proposed Action and Alternatives

This chapter defines the GHPA boundaries, describes the existing and historic disturbances associated with uranium extraction present within the GHPA (Section 2.2, No Action Alternative), discusses the proposed development and activities that would occur during construction, operation, and decommissioning of the Project (Section 2.3, Proposed Action), and describes the alternatives analyzed in this document (Section 2.4, Resource Protection Alternative and Section 2.5, Alternatives Considered but Eliminated from Further Consideration). In developing the alternatives, the BLM followed guidance set forth in the BLM NEPA Handbook (H-1790-1), which provides for the development of a range of reasonable alternatives. Based on this guidance, the BLM developed the following alternatives for analysis in this EIS.

- **No Action Alternative:** This alternative assumes that approval of Cameco's Project is denied and certain existing infrastructure would be removed to release currently existing bonds. Exploration drilling would continue at a rate that would disturb less than 5 acres a year (Section 2.2, No Action Alternative).
- **Proposed Action Alternative:** This alternative consists of Cameco's proposal to develop 5 mine units and associated infrastructure within the GHPA to extract up to an estimated 2.5 million pounds of uranium oxide (U_3O_8) concentrate per year using ISR technology (Section 2.3, Proposed Action).
- **Resource Protection Alternative:** This alternative consists of Cameco's Project with the use of closed loop drilling systems and modifications to reduce the environmental impact of the project. Modifications include on-site processing of resin to produce slurry (Section 2.4, Resource Protection Alternative).

The No Action Alternative and each of the Action Alternatives are discussed in terms of alternative-specific activities, alternative-specific design features, and surface disturbance summaries. Alternatives considered but eliminated from detailed analysis are discussed in Section 2.5, Alternatives Considered but Eliminated from Further Consideration. The impact analysis of each alternative in Chapter 4.0, Environmental Consequences, focuses on the new disturbance that would occur under each alternative. Analysis of the cumulative impacts to the region in Chapter 5.0, Cumulative Impacts, describes the incremental impact of Project disturbance when added to other past, present, and reasonably foreseeable future actions in the area.

2.1 Existing Infrastructure and Disturbance in the Gas Hills Project Area

The GHPA is located in central Wyoming (**Figure 1-1**). The majority of the GHPA, Sections 21, 28, 29, 33, 32, and portions of Section 31 in T33N, R89W; and Sections 5 and 11 and portions of Sections 1, 3, 10, and 12 in T32N, R90W, is located in Fremont County under the jurisdiction of the BLM Lander FO. The remainder of the GHPA (Sections 22, 27, and portions of Section 34 within T33N, R89W) is within Natrona County and under the jurisdiction of the BLM Casper FO. Portions of Section 6 of T32N, R89W also are within Natrona County but are under the jurisdiction of the BLM Lander FO (**Figure 1-1**).

2.1.1 Existing Infrastructure

Within the GHPA, approximately 131 acres currently are disturbed by existing roads, utilities, or structures (**Figure 2-1**). The Project would use and maintain portions of this existing infrastructure to support mining activities.

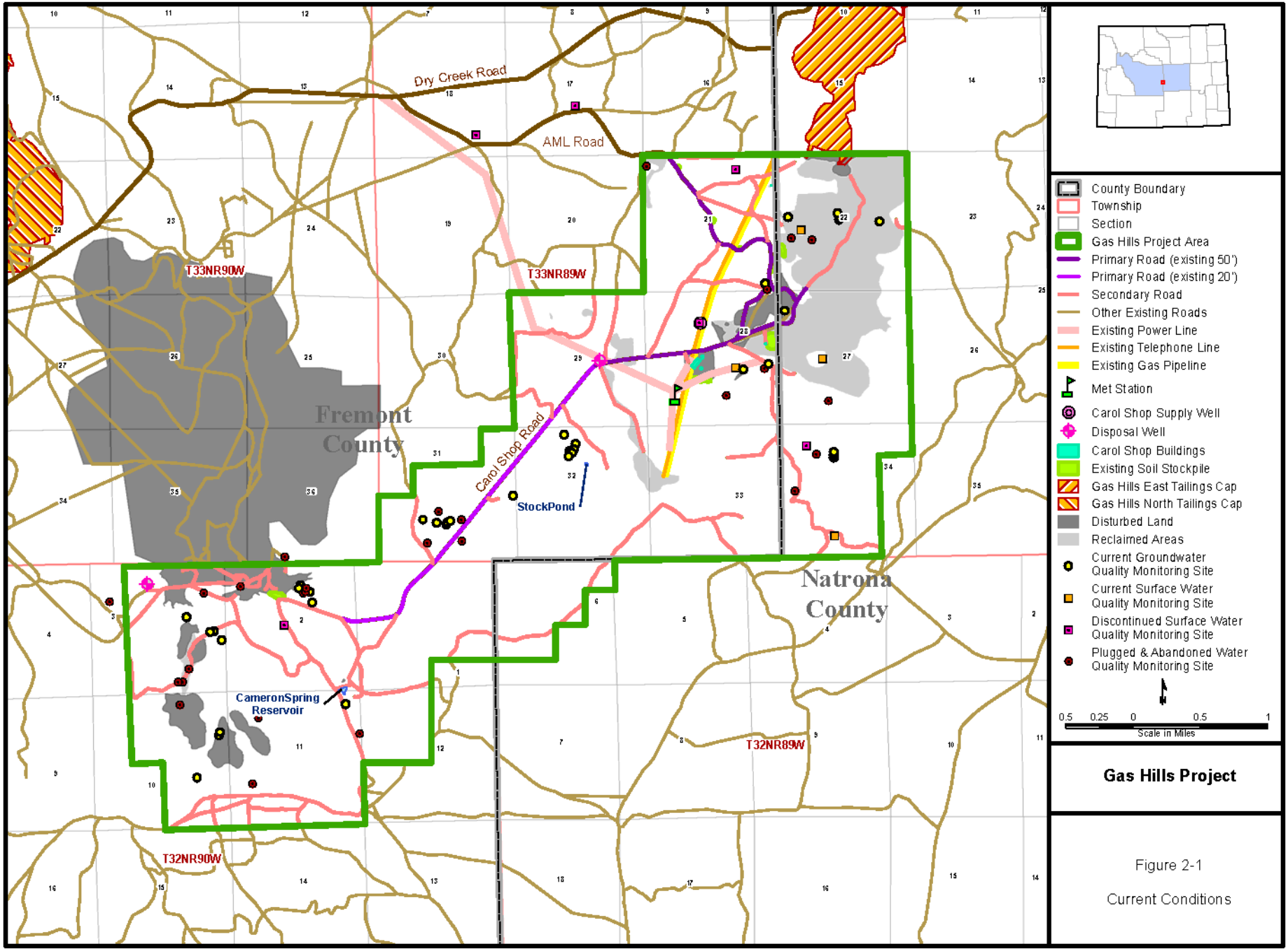


Figure 2-1

Current Conditions

Two main roads exist within the GHPA, the AML road (approximately 2.8 miles, or 17 acres) and the Carol Shop Road (approximately 5.8 miles, or 25 acres). The AML road provides access to the site at its origin where it intersects the Dry Creek Road which traverses the Gas Hills Region from its intersection with Wyoming State Highway 136 to its eastern terminus at the Natrona county line (**Figure 2-1**). In addition to the main roads within the GHPA, many smaller, predominantly 2-track roads currently exist. Many of these are roads historically used for exploration drilling and ongoing grazing activities. These roads currently disturb approximately 28.3 miles (68.6 acres) within the GHPA.

One existing structure and associated disturbance, the Carol Shop facility, occupies approximately 27 acres within NE¼ of the SW¼ (NESW Qtr/Qtr) of Section 28, T33N, R89W. This structure is a large, multiple-bay building that was used as a maintenance shop for past uranium mining activities.

Approximately 2.8 miles of overhead power lines that historically supplied power to the Carol Shop facility and other historic mine areas currently are located in Sections 28, 29, and 33, T33N, R89W.

Several piles of topsoil, originally developed for eventual reclamation of the Carol Shop facility and main roads, are distributed throughout the GHPA and occupy approximately 3.1 acres.

A meteorology monitoring station was completed in December 2010 within the SW¼ of T33N, R89W, Section 28, on approximately 0.1 acre. This monitoring station may be in use as long as the anticipated 25-year life of the Project. Two deep disposal test wells were drilled in 2011 on approximately 4 acres.

2.1.2 Existing Disturbance

Of the approximately 8,500 acres within the permit boundary, approximately 15 percent, or 1,300 acres, has previously been disturbed by mining activities, mining exploration and off-highway vehicle (OHV) use (**Figure 2-1**). Vegetation has re-established on the majority of these lands (approximately 900 acres); existing roadways, structures, and the Buss I Pit Lake in Section 27 of T33N, R89 remain disturbed (approximately 400 acres). The revegetated areas generally have a diverse species composition, although some lands in the northern portion of the GHPA are primarily a monoculture (crested wheatgrass). Sources of disturbance primarily are related to mining and associated infrastructure, as described in the following section.

2.1.2.1 Historic Mining

From the 1950s to the early 1980s, much of the surface area within and adjacent to the GHPA was extensively mined for uranium employing both underground and surface mining methods. The majority of the uranium ore was recovered by surface mining methods. Additionally, exploration drilling and associated access road construction completed since the 1950s has disturbed portions of the GHPA. Many of the historical drilling access roads still exist.

At least 12,000 exploration boreholes have been drilled by Cameco and previous mineral rights owners within the GHPA since the 1950s; these boreholes were constructed and abandoned according to rules and regulations in place at the time. This previous drilling has disturbed an estimated 260 acres within the 5 proposed mine units, or 27 percent of the approximately 977 acres within mine unit boundaries. Numerous historical open-pit or underground mining operations were located within and adjacent to the GHPA.

A portion of 1 historic uranium mining operation, the Gas Hills East (Umetco Minerals Corporation), is located on portions of Sections 22, 15, and 16, T33N, R89W, directly adjacent to the GHPA. This location includes a cap over historic uranium tailings, which is visible in **Figure 2-1**. Management of this capped area is currently being transferred to the Department of Energy, Office of Legacy Management (LM) under UMTRCA. Once transfer is complete the LM will implement a Long-term Surveillance Plan (LTSP), which will include inspection, monitoring, maintenance, and emergency measures designed to protect public health, safety, and the environment. For purposes of this EIS the BLM assumes that

management of the capped area under the LTSP would not impact Cameco's ability to develop their mining claims.

The Lucky Mc (also called the Lucky Mac) mine operated between 1957 and 1988, as both an underground and open pit mine, and is currently owned by Pathfinder Mines Corporation. Portions of this mine is within the GHPA (Sections 25, 26, 27, 35, and 36 of T33N, R90W). Rehabilitation of the site began in 1991, and the ore processing facility was demolished in 1993. U.S. NRC determined that reclamation of mill tailings for the Lucky Mc (the Gas Hills North Tailings Cap) was complete in 2006. The site is not actively mined, and portions of the mine adjacent to the GHPA (in Sections 9, 10, 15, 21, and 22 of T33N, R90W) are currently being considered for transfer to LM under UMTRCA.

Exploration Drilling

Almost 1,000 of the existing boreholes and wells in the GHPA were drilled and installed by Cameco between 1996 and 2010. Boreholes were abandoned according to applicable rules and regulations. No drilling occurred during 2005-2006. Reclamation of recent exploration drilling activity takes place on an on-going basis and typically is completed within 1 year of the initial disturbance. In September 2008, Cameco plugged and abandoned 12 inoperable site monitoring wells.

2.2 No Action Alternative

Under the No Action Alternative, none of the proposed uranium mining or associated activities would occur within the GHPA. Currently, Cameco would be responsible for the removal and reclamation of the existing Carol Shop facility and a portion of the AML road running from the GHPA boundary in the NW¼ of Section 21, T33N, R89W to the Carol Shop (**Figure 2-2**). Reclamation would be required to meet performance obligations, currently secured by bonds, and would include the redistribution of topsoil currently stockpiled within the GHPA (**Figure 2-2**). Under this Alternative, the Carol Shop facility would be removed and approximately 26.7 acres of disturbance would be reclaimed. If no other need for the AML road were determined, 1.8 miles also would be removed and approximately 10.9 acres (based on the current 50-foot disturbance for the road) would be reclaimed. Topsoil stored on approximately 2.6 acres would be redistributed on reclaimed areas. Existing notice-level activity within the GHPA also would be reclaimed. Under this alternative, a total of approximately 40.2 acres (less than 1 percent) within the GHPA would be reclaimed.

New disturbance associated with continued exploration activities could continue within the GHPA for any NOI accepted by the BLM for activities authorized under the 43 CFR 3809 surface management regulations. Exploration-related activities on BLM-managed lands may not result in over 5 acres of unreclaimed surface disturbance at any time during the life of the Notice of Intent filed for each action. Reclamation of these sites would be anticipated to occur within the same calendar year as the disturbance.

Analysis of the No Action Alternative is required under NEPA (43 CFR Section 1502.14[d]). The No Action Alternative may be selected by the BLM if the agency disapproves Cameco's PoO because the Project would cause undue or unnecessary degradation to resources managed by the agency (43 CFR, Section 3809.411[d][3][iii]).

2.3 Proposed Action

Cameco proposes the development of uranium deposits in the GHPA through implementation of the ISR process, which involves recovery of uranium from the subsurface through chemical dissolution using wells constructed similarly to conventional water wells (Proposed Action). The process requires installation of surface infrastructure (processing facilities, waste water disposal facilities, roads, header

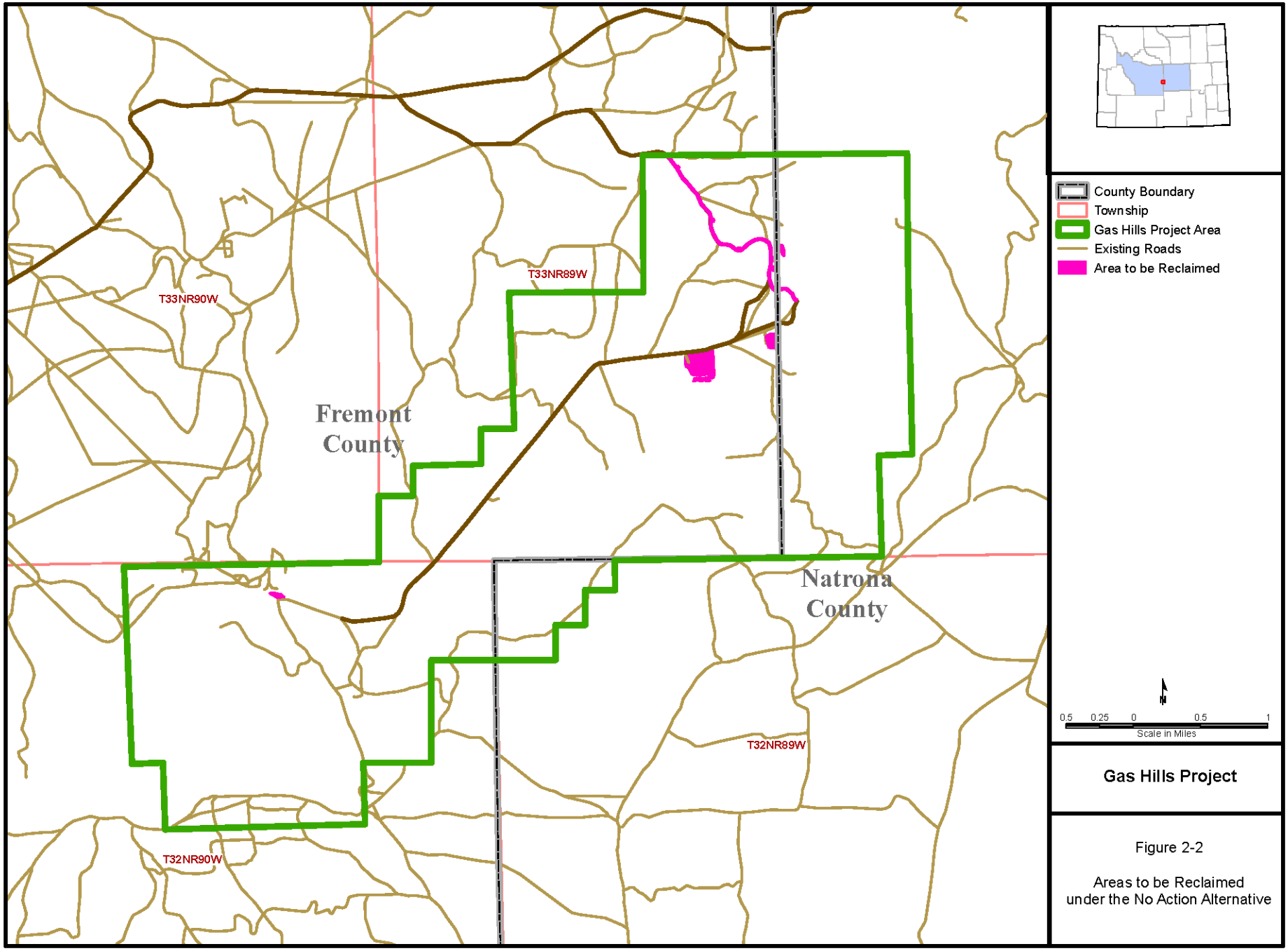


Figure 2-2

Areas to be Reclaimed under the No Action Alternative

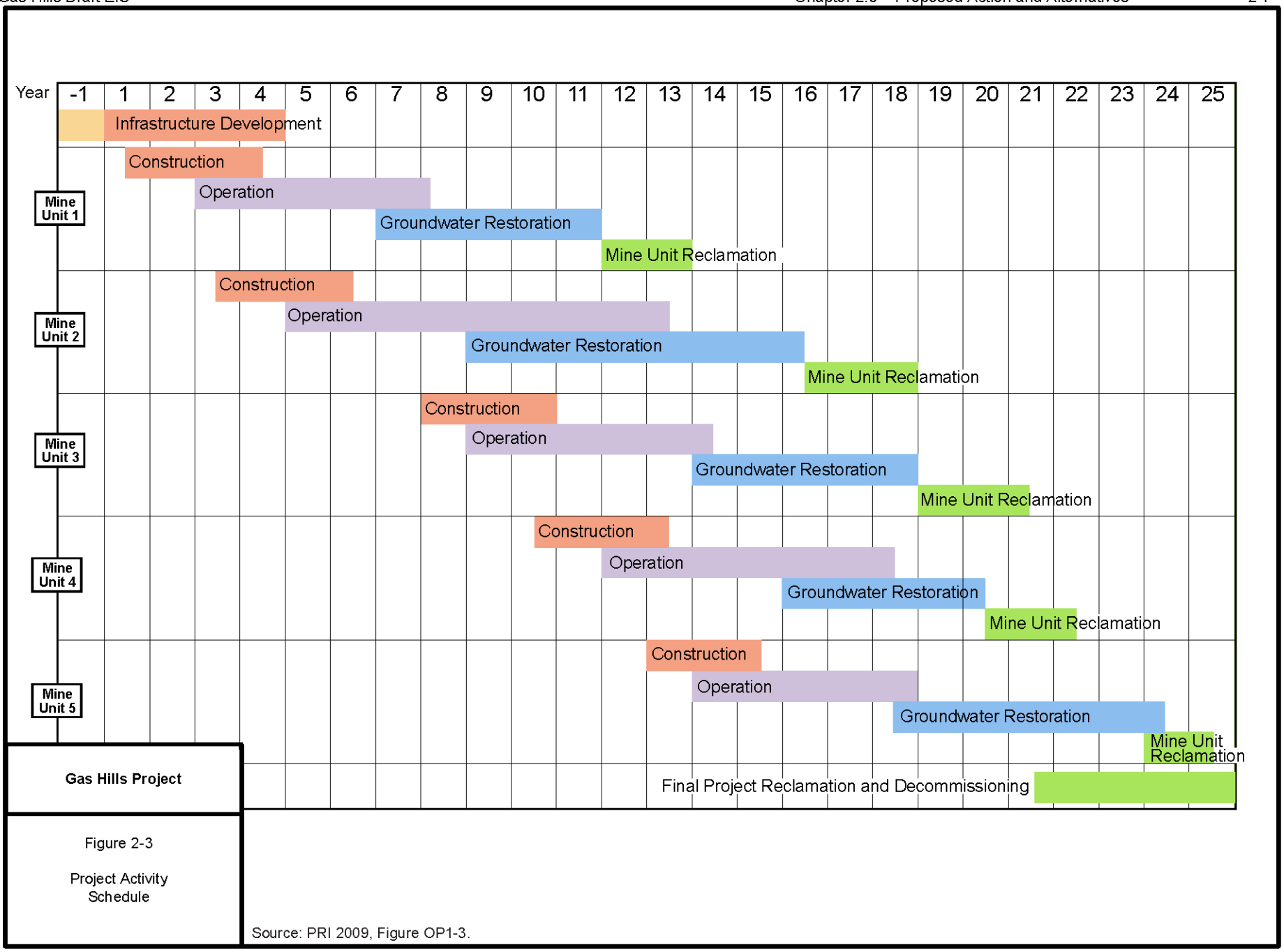
houses, and power lines) as well as subsurface infrastructure (wells, pipelines, electrical lines, and communication cables). Activities associated with the Proposed Action would occur throughout the projected 25-year span of the Project, and would include the following phases:

1. **Infrastructure Development** – Construction or improvement activities occurring within the GHPA, but outside of mine units, including: upgrades to project infrastructure within the GHPA (roads, electrical lines, water disposal, and pipelines); and construction or upgrades to processing facilities (Section 2.3.1, Infrastructure Development)
2. **Mine Unit Construction** – Construction activities occurring within mine units, including: delineation drilling; installation of injection, production and monitoring wells, pipelines, booster pump stations, header houses, and roads to header houses (Section 2.3.2, Mine Unit Construction).
3. **Mine Unit Operation** – Operation of the ISR process to remove and process uranium; interim reclamation of the majority of the mine unit construction disturbance (Section 2.3.3, Mine Unit Operation).
4. **Mine Unit Restoration and Reclamation** – Restoration of groundwater; and decommissioning and removal of mine unit infrastructure and final surface reclamation within each mine unit (Section 2.3.4, Personnel/Work Force).
5. **Final Project Reclamation and Decommissioning** – Decommissioning and reclamation of surface and subsurface infrastructure within the GHPA but outside of the mine units, such as evaporation ponds, roads and satellite facilities (Section 2.3.5, Mine Unit Restoration and Reclamation).

Descriptions of the various aspects of the Project are derived in part from the Revised PoO (PRI 2011a) and Cameco's WDEQ mine permit update – Permit 687 (PRI 2009). General descriptions of ISR project components were derived from the U.S. NRC's Generic EIS for ISR facilities (U.S. NRC 2009) in addition to the information in the WDEQ mine permit update. These activities may occur simultaneously while different mine units are constructed, operated, and reclaimed during the span of the Gas Hills Project (**Figure 2-3**).

For the purpose of analysis, it is assumed that the surface within a mine unit would be completely disturbed during construction activities, although it is possible that small patches of vegetation may be left intact. See **Appendix A**, **Figure A1** for a typical mine unit pattern. Surface disturbance within a mine unit would be phased over several years at a rate that would depend on the uranium production rate and the availability of mine construction equipment and personnel. During operations, approximately 95 percent of the mine unit would undergo interim reclamation, and the remaining 5 percent would remain disturbed during operations for roads, header houses, well heads, and power lines. Access to well heads during mine unit operation would cause compaction and disturbance on an estimated 45 percent of the mine unit, for a total disturbance of 50 percent. The mine unit surface would again be completely disturbed during mine unit decommissioning, after which the mine unit would undergo final reclamation. Final reclamation would include plugging and abandoning all wells, removing header houses and buried piping, and re-grading and seeding the disturbed surface.

The surface disturbance associated with facilities within the GHPA but outside of mine unit boundaries, such as evaporation ponds, wastewater deep disposal wells or mineral processing and water treatment facilities, would remain for the projected 25-year life of the Project. At the end of the Project, all of these facilities would be decommissioned or removed and disturbed areas would be reclaimed to the pre-mining land use. Disturbances associated with the Proposed Action are summarized in **Table 2-1**.



Gas Hills Project

Figure 2-3

Project Activity Schedule

Source: PRI 2009, Figure OP1-3.

Table 2-1 Proposed Action Disturbance Summary

Mine Component	Disturbance (acres)	
	Construction/ Decommissioning (+15 percent)[a]	**Operation (+15 percent)[a]**
Mine Unit Disturbance, Including Monitoring Well Ring		
Mine Unit 1[b]	156 (179)	78 (90)
Monitoring well ring for Mine Unit 1[c]	11 (13)	6 (7)
Mine Unit 2[b]	365 (420)	183 (210)
Monitoring well ring for Mine Unit 2[c]	10 (12)	6 (7)
Mine Unit 3[b]	90 (103)	45 (52)
Monitoring well ring for Mine Unit 3[c]	10 (12)	6 (7)
Mine Unit 4[b]	255 (293)	128 (147)
Monitoring well ring for Mine Unit 4[c]	9 (10)	5 (6)
Mine Unit 5[b]	111 (127)	56 (64)
Monitoring well ring for Mine Unit 5[c]	8 (9)	4 (5)
Subtotal for Mine Unit Disturbance	**1,025 (1,178)**	**517 (595)**
Project Infrastructure Outside of Mine Units		
Roads/Utility Corridors[d]	209	38
Surface Facilities		
Carol Shop Facility[e]	0	0
Satellite Facility[f]	10	10
Evaporation Ponds and Diversions	62	62
Disposal Wells[g]	6	3
Topsoil Stockpiles	3	3
Subtotal for Disturbance Outside of Mine Units	**290**	**116**
Grand Total	**1,315 (1,468)**	**633 (711)**

[a] Mine Unit area may expand based on results of delineation drilling; to account for this possible expansion, disturbance estimates for mine units and their associated monitoring well rings are conservatively increased by 15 percent.

[b] Disturbance of the entire Mine Unit is anticipated during construction and decommissioning. Operational disturbance for facilities (primary and secondary roads, header houses, valve boxes, and well heads) is conservatively estimated to be 5 percent of the Mine Unit area. The remaining 95 percent of the Mine Unit would undergo interim reclamation for the duration of operations; however, an estimated 45 percent of the Mine Unit would be impacted by cross-country mechanized travel to well heads, for a total of 50 percent disturbance of a Mine Unit during operation.

[c] Construction disturbance for monitoring well rings is based on a disturbance width of 18 feet. Operational disturbance for monitoring well rings is based on a disturbance width of 10 feet.

[d] Road/utility corridor construction disturbance for new, existing, and upgraded existing roads is based on a width of 60 feet for primary roads, 40 feet for secondary roads, 50 feet for underground utilities, and 30 feet for overhead power lines. Road/utility corridor operational disturbance based on a width of 30 feet for primary roads and 15 feet for secondary roads; utility corridors would undergo interim reclamation during operations. Includes disturbance for approximately 1.4 miles (8.3 acres, based on a 50-foot wide disturbance) for a process water pipeline that would not be adjacent to a proposed road.

[e] The Carol Shop facility is located on 27 acres of existing disturbance and would not involve new disturbance under the Proposed Action.

[f] Conservatively includes the disturbance for both proposed satellite facility locations although only 1 would be constructed. Disturbance for each location (approximately 5 acres) includes the building plus additional area for parking and access.

[g] Based on disturbance of 2 acres for construction and 1 acre for operation of each of 3 proposed disposal well locations. Two deep disposal test wells were drilled in 2011; further development will require re-disturbance.

2.3.1 Infrastructure Development

2.3.1.1 Satellite Facilities

The proposed satellite facilities would be centrally located buildings containing equipment for preparing ISR solutions, as well as the ion-exchange equipment for stripping uranium and other materials from water used in the ISR process. Cameco proposes to use the existing Carol Shop facility for the first satellite facility to be developed for the Project. The existing building would be upgraded to house the central water treatment facility, ion-exchange columns, associated equipment and piping, offices, and maintenance facilities. One additional satellite facility would be constructed to house additional ion-exchange, resin loading and unloading, and future reverse osmosis (RO) capacity located at either of 2 possible satellite locations, as shown in **Figure 2-4**. While Cameco may decide not to build the additional satellite facility, the BLM has assumed Cameco would construct 1 additional facility at 1 of the 2 possible locations, both of which are analyzed in this EIS.

2.3.1.2 Waste Management

Wastewater Disposal Facilities

Water from which uranium has been removed using ion-exchange equipment may be re-used in the ISR mining process or be disposed of during mine operation. Liquid waste produced during operations primarily would be from process wastewater streams consisting of well-field bleed, RO brine fluids, and satellite washdown water.

Cameco proposes 2 water disposal methods for use in the Proposed Action. The first method would be disposal into solar evaporation ponds that would be designed and constructed to contain the water volume to be disposed of during Project operation. Evaporation ponds would be lined, the perimeter would be bermed to prevent run-on of surface drainage and fenced to exclude wildlife and livestock, and the ponds would be located similarly to those shown in **Figure 2-4**. Topsoil excavated from the ponds would be segregated and stockpiled in long-term topsoil stockpiles. Evaporation ponds would be fenced following BLM Handbook H 1741-1 standards to prevent both livestock and large game animals from accessing the ponds. Although waterfowl are not anticipated to use the evaporation ponds, Cameco will monitor the ponds for waterfowl activity and implement measures to remove, exclude, or deter them if necessary.

The evaporation ponds would be designed to operate in pairs as below-grade impoundments during regular operation, where the excavated materials would be piled above-grade for additional storage capacity, surface water isolation, and freeboard requirements. See **Appendix A**, **Figure A-2** for more specific pond design. Ponds would be operated essentially at one-half capacity to allow for the evacuation of one pond's contents into its partner in the event that a pond requires servicing.

Each evaporation pond would be lined with a 60 millimeter high density polyethylene liner (or equivalent). Leak detection would be installed under the liner, consisting of a secondary compacted clay liner (maximum permeability of 10^{-7} centimeters per second) or 30 mil polyvinyl chloride liner (or equivalent). Leak detection piping would be situated between the two liners in granular backfill with gravity flow to an inspection manhole.

The evaporation ponds, berms, surface water diversions, storm water control measures, and leak detection inspection manhole would be visually inspected daily. The manhole sump pump would be tested at least once every two weeks. In the event the sump pump is observed operating, a water sample would be collected and analyzed for chloride, bicarbonate, and conductivity. If the analysis indicated the ponds to be leaking, the contents of the leaking pond would be transferred into another pond, the U.S. NRC and WDEQ-LQD would be notified within 48 hours and a written report would be submitted within 60 days. An investigation would be conducted to determine the source of the leak, and once identified, the leak and any damage to the system would be repaired. Additional testing and

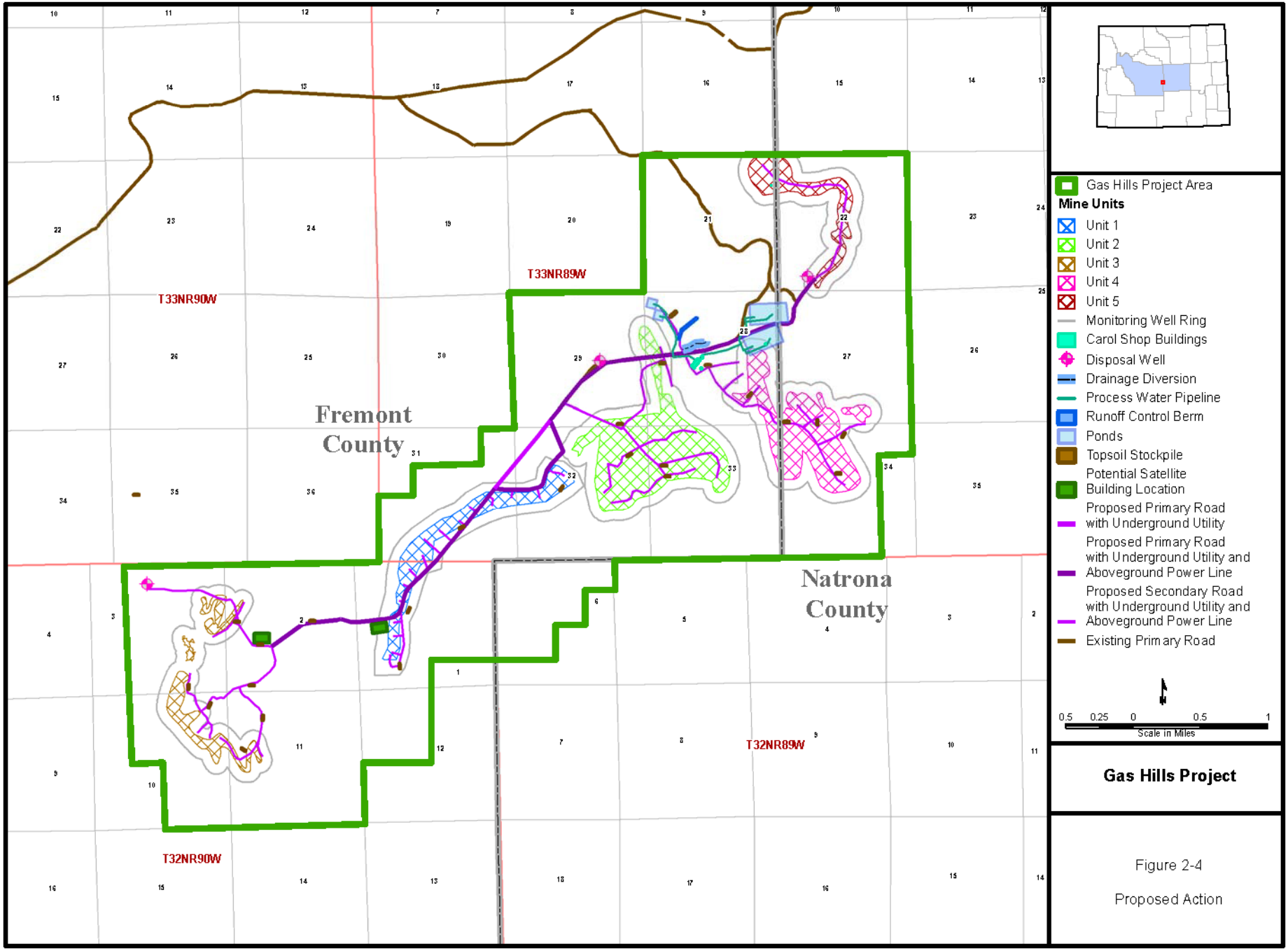


Figure 2-4

Proposed Action

sampling would continue when pond operation resumed, and a final written report would be submitted describing all remedial and repair activities within 60 days after repairs have been completed (PRI 2009).

To augment the solar evaporation pond capacity over time, forced evaporation and crystallization equipment would be added within the Carol Shop facility at the beginning of operational Year 6. The distillation and crystallization process would heat the wastewater feed to the boiling point; the steam would be allowed to cool resulting in a condensate of distilled water. The distilled water would be consumed in the plant, used as a source of restoration water, used for mine unit hydrologic control, or stored in ponds. Waste brine generated by the evaporator would be transferred to the crystallizer where it would be heated to drive off residual moisture and reduced to a dry solid that can be removed and stored for disposal at a permitted disposal facility (PRI 2011a).

The second wastewater disposal method would be to use 1 or more Class I injection wells (wells that inject industrial or municipal non-hazardous wastes below the deepest underground source of drinking water) for deep injection of wastewater. Cameco is evaluating whether deep disposal wells are technically feasible by drilling to the target geological formation, and testing the formation's ability to receive the desired volume of water. Two deep disposal test weels were drilled in 2011, and testing is anticipated during 2012. Current target formations include the Cloverly, Morrison, Nugget, Phosphoria, Tensleep, Madison, and Flathead formations which range in depth from 800 to over 4,000 feet. If a deep disposal well for wastewater is technically feasible, Cameco would apply for a permit from WDEQ-WQD (with concurrence from USEPA) to employ deep wastewater injection as the primary means of water disposal. Use of deep disposal wells for wastewater would reduce the volume of solid material in evaporation ponds that would eventually require disposal at off-site permitted facilities as discussed in Section 2.3.3.1, In-situ Recovery.

Three candidate test well locations for deep disposal wells have been identified (**Figure 2-3**). If testing of the first well indicates that it would be suitable for injection of wastewater, Cameco would permit the well for disposal, and would drill up to 2 additional disposal wells at the alternate locations. For purposes of analysis in this EIS, the BLM has assumed that both water disposal methods would be developed for the Project.

Hazardous Materials

Any hazardous or toxic materials used for uranium processing would be handled, stored, and/or disposed of in accordance with state and federal hazardous materials requirements and pursuant to standard operating procedures.

Storm Water

Construction disturbances and associated potential for the discharge of pollutants in the form of surface materials and sediment into Waters of the State (defined as all surface and groundwater, including waters associated with wetlands, within Wyoming) via storm water runoff would be controlled using Best Management Practices (BMPs) as described in Cameco's Gas Hills Project Storm Water Pollution Prevention Plan (SWPPP). The SWPPP was prepared as part of the Gas Hills WDEQ-WQD General Permit No. WYR103870 to discharge storm water associated with large construction activity under the Wyoming Pollutant Discharge Elimination System. The SWPPP would be modified with any change in design, construction, operation or maintenance that may change the potential for the discharge of pollutants into Waters of the State. A copy of the SWPPP currently is maintained at the Gas Hills site. When operations commence at the GHPA, this construction permit would be converted to an industrial activity permit.

Sewage

Domestic sewage also would be produced and would be handled by conventional septic/leach field systems. In addition to the existing system at the Carol Shop facility, other systems would be constructed at alternate satellite locations. These systems would be intended to receive non-contaminated wastes

from restrooms, shower facilities, and miscellaneous sinks located within the Project facilities. A new well would be drilled to provide domestic water for the showers and other sanitary facilities at the Carol Shop facility. Temporary chemical toilets would be used in well-field and drilling areas when use of the satellite facilities is time consuming or inconvenient.

Solid Wastes

During operations, non-contaminated wastes as defined by the AEA would include office and food wastes, paper and wood products, and steel. These wastes temporarily would be stored on-site and periodically transported to a municipal landfill by a contract waste disposal operator.

Radiologically contaminated wastes would be generated during the uranium recovery operations. These wastes would include process pipe and equipment, tanks and vessels, ion-exchange resin, filter media, and the solid residue and liners from the evaporation ponds. An estimated maximum of 300 cubic yards of contaminated waste could be generated per year by the Project. Cameco currently has a contract disposal agreement with Denison Mines to dispose of these Gas Hills byproduct wastes at their Blanding, Utah facility.

2.3.1.3 Access Roads

Existing major roadways would provide access to the GHPA, and new or upgraded existing roads would provide access within the GHPA between the 5 mine units. Three types of roads would be used during Project construction and operation: primary and secondary roads would be constructed, graveled, and maintained for the use of the Project and would be designed for designated speed limits; and 2-track roads would be developed for light use, primarily as access to perimeter monitoring wells surrounding mine units. The BLM would require that all roads for the Project be built to BLM standards (The Gold Book, USDOI and USDA 2007), which include road grade less than 8 percent, except for pitch grades of less than 300 feet.

The Carol Shop Road would be the primary road within the GHPA, with a speed limit of 40 miles per hour (mph). Year-round access to and from the GHPA would be over existing State Highway 136 (also known as the Gas Hills Road) from Riverton, Wyoming, to the Dry Creek Road, connecting with the Carol Shop Road (**Figure 2-5**) via the AML road. Alternate access to the GHPA would be via Fremont County Road No. 5 (also known as the Ore Road or Haul Road) from Jeffrey City to the Dry Creek Road, or via Natrona County Road No. 212 (also known as the Gas Hills Road or Waltman Road) from Waltman to the Carol Shop Road. All vehicles travelling on public roads would comply with the Wyoming Highway Department's Rules and Regulations. As each mine unit is delineated, designed and developed, secondary access roads would be required to provide access to each of the header houses within the mine units.

Access to well heads and monitoring wells within mine units would be cross-country; no grading for this access would occur except in areas where the slope exceeds 25 percent.

Roads would be constructed as shown in **Appendix A, Figure A-3** for typical road construction details. Primary and secondary access roads would use culvert crossings at significant drainages (see **Appendix A, Figure A-4** for a typical culvert installation). Primary access roads would be 30 feet wide with a 60-foot right-of-way (ROW), and secondary access roads would be 15 feet wide with a 40-foot ROW. Most traffic at the Project site would be limited to pick-up trucks and typical over-the-road drill rigs, flatbed trucks, and other similar vehicles. Reduced speed limits would be posted and maintained on access roads for employee safety and to minimize the potential for collision with wildlife.

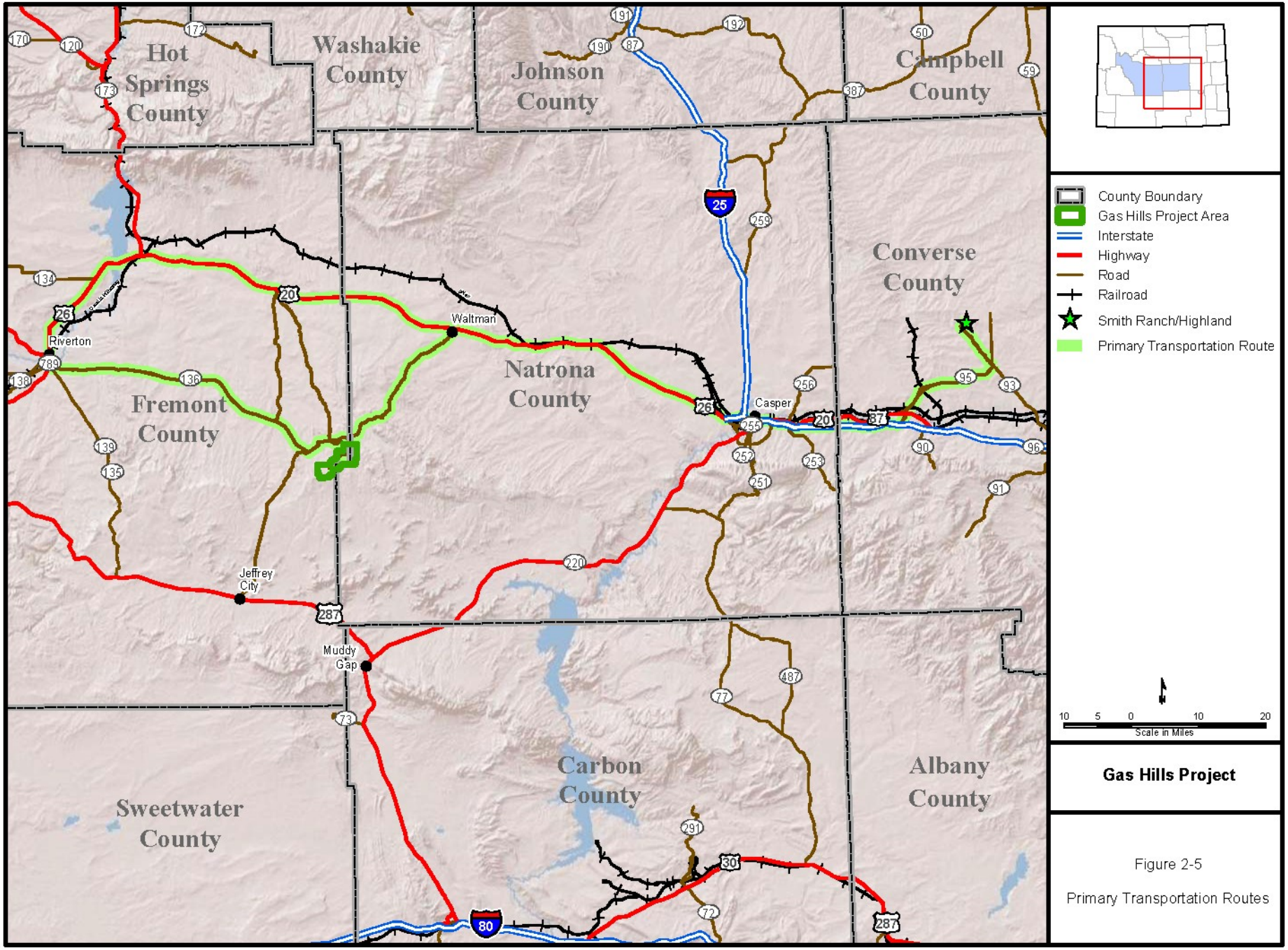


Figure 2-5

Primary Transportation Routes

2.3.1.4 Pipelines

Underground pipelines would be installed between the satellite and water disposal facilities (both evaporation ponds and disposal wells). Pipelines also would be installed between the satellite facilities and the header houses at the mine units within existing or proposed road ROWs.

If large, inflexible, or multiple pipelines are placed in a trench, Cameco would construct the pipeline trench with an excavator or backhoe and would stockpile, and then immediately replace the topsoil. In some cases, and where small flexible pipe is installed, Cameco would use a trenching machine or spider plow. These types of machines do not require topsoil segregation and reduce the overall disturbance footprint and intensity.

2.3.1.5 Power Lines

Aboveground power lines would be constructed within proposed or existing road ROWs from the existing power lines terminating near the Carol Shop facility to each of the header houses within the mine units. New power lines would be constructed to minimize potential electrocution hazards to raptors by following the guidance in "Suggested Practices for Raptor Protection on Power Lines - The State of the Art in 2006," by the Avian Power Line Interaction Committee (APLIC) (2006).

2.3.1.6 Water Use

All water used for the Project would be obtained from groundwater within the GHPA appropriated in accordance with state requirements. Surface and groundwater rights appropriations in the area historically have been used for livestock watering, by wildlife, and for limited non-industrial domestic purposes associated with past mining operations. No public water supply wells or intakes are located within the GHPA.

Table 2-2 lists the estimated water volumes to be used by the Project over the life of the planned operations. It is estimated that the maximum annual volume of groundwater that would require disposal over the life of the Project would be 420 acre-feet. This water would be disposed of using methods described in Section 2.3.1.2, Waste Management, of this document.

Table 2-2 Projected Water Disposal

Year of Operation[a]	Water Flow (acre-feet/year)[b]	Water Consumed (acre/ft/year)[c]
1	4,516	9
2	9,033	18
3	11,452	23
4	13,711	27
5	15,324	205
6	15,969	350
7	18,550	418
8	19,195	420
9	18,388	418
10	17,420	416
11	16,614	415
12	16,130	414

Table 2-2 Projected Water Disposal

Year of Operation[a]	Water Flow (acre-feet/year)[b]	Water Consumed (acre/ft/year)[c]
13	15,646	413
14	12,517	407
15	10,014	402
16	7,010	396
17	4,907	391
18	3,434	389
19	2,405	387
20	1,682	64

[a] Year of operation is based on the first full year of ISR mining and does not include the period for construction of Mine Unit 1 or for construction of Project infrastructure.

[b] One acre-foot is equivalent to approximately 325,851 gallons.

[c] Volume of water per year circulated through the Project infrastructure and the subsurface ore zone to extract uranium from the subsurface and to accomplish groundwater restoration. Most of this water would be recycled through the system multiple times.

[d] Volume of water per year that would be disposed of each year of system operation. This volume would constitute consumptive use by the Project.

Source: Table OP3-3, Operations Plan (PRI 2009).

2.3.2 Mine Unit Construction

Construction of each mine unit would involve disturbance of the entire mine unit ground surface for the following activities, each of which are described in greater detail later in the section:

- Delineation drilling to refine ore body limits;
- Hydrologic testing;
- Installation of injection, production, and monitoring wells;
- Construction of primary and secondary access roads within mine units, and installation of underground utilities (piping, power lines, communication cables); and
- Construction of header houses.

Surface disturbance within each mine unit would not occur all at once but would be sequenced over several years, depending on the uranium production rate and on the availability of mine unit development and construction equipment and personnel. Cameco anticipates it would take 2 to 3 years to complete the construction of a mine unit, including injection/production wells, pipeline/electrical power corridors, header houses, and access roads associated with a given mine unit. Each mine unit would be constructed sequentially, and Cameco would not have more than 2 mine units in production at any one time. Additionally, Cameco would not begin production in Mine Unit 4 until groundwater restoration (as described later in this document in 2.3.5.1, Groundwater Restoration) was completed. **Appendix A, Figure A-1** illustrates a typical mine unit pattern installation consisting of injection wells, production wells, monitoring wells, pipelines, access roads, power lines, and a header house.

In addition to truck-mounted rotary drill rigs and water trucks, other equipment employed during mine unit construction would include truck mounted pump pulling units, truck-mounted hose reels, electrical generators, backhoes, and light duty 4-wheel drive vehicles. **Figures 2-6** and **2-7** show typical arrangement of the vehicles during the 3 to 5 days it generally takes to drill each well. Mine unit construction also would require the use of temporary cement batch plants within mine units to support well and header house installation. Additional ancillary construction material would be contained within the Carol Shop facility or mine unit disturbance areas.

2.3.2.1 Delineation Drilling

The shape, distribution, and grade of the uranium deposits determine the location and shape of mine units, as well as the final injection or production well placement, well density, and the resulting supporting facilities (e.g., roads and pipelines). To determine the extent of the deposits, multiple test holes would be drilled in a process called delineation drilling, which would determine the final location of ISR wells. The surface disturbance footprint for all delineation boreholes would be within each mine unit (see assumptions in **Table 2-1**). Delineation drilling would occur throughout each year, depending on production and development needs. Typically, 200 to 500 delineation drill holes would be completed each year.

Delineation holes would be constructed using truck mounted rotary drill rigs and water trucks (**Figures 2-6** and **2-7**). Materials removed from the boreholes during drilling (drilling mud) would be collected in temporary pits (drilling mud pits). The drilling mud pits would be fenced until the contained fluid has been removed or has evaporated and the pits have been reclaimed. Topsoil from drill holes and drilling mud pits would be salvaged and placed in short-term stockpiles.

An average of 14 drill rigs are anticipated to operate on-site simultaneously for delineation drilling. Once information from each borehole is gathered and logged, it would be plugged and abandoned.

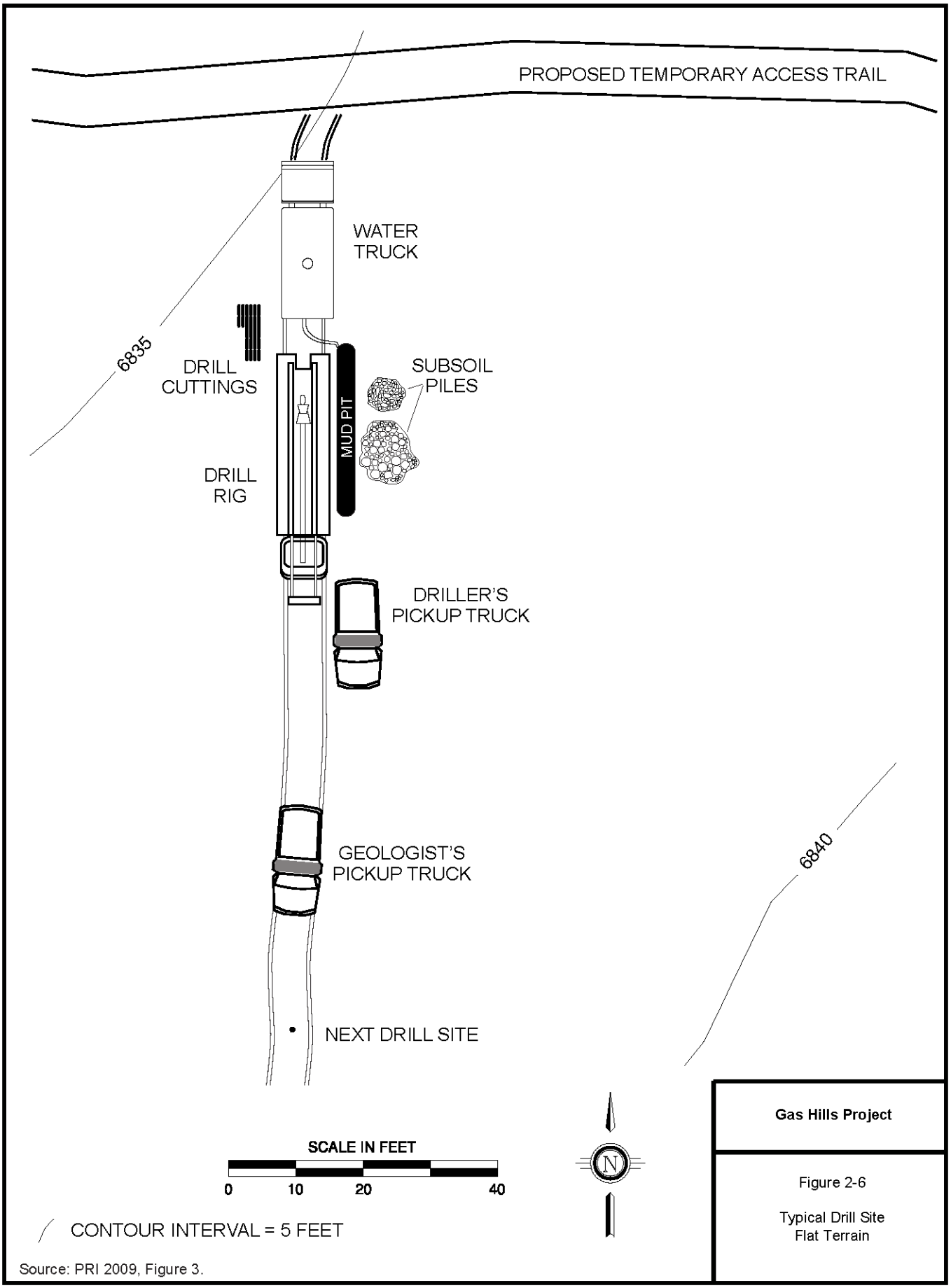
The drilling mud pit would be allowed to dry out for several days prior to backfilling. Prior to drill hole abandonment, techniques such as siphoning the water from the pit back into the drill hole or removing excess water from the pit for use at other drill sites may be used to expedite drilling mud pit reclamation. After backfilling the drilling mud pits with subsoil, the pits would be allowed to settle before applying the topsoil and performing final grading. Compaction may be used to further reduce potential settling of reclaimed drilling mud pits. Steep slope sites and access routes would be reclaimed using a dozer, track hoe, or similar equipment to minimize the surface disturbance.

Drill sites that would become part of a mine unit within 1 year of drilling would not be seeded until mine unit construction is complete. Those sites that would not become part of a mine unit within 1 year would be seeded after drilling mud pit reclamation is complete. In either case, seed would be planted during the next available seeding window, spring or fall.

2.3.2.2 Hydrologic Testing

Following completion of delineation drilling, detailed hydrologic testing would be conducted for each mine unit based on site-specific test plans. The purpose of the tests would be to collect and assemble detailed geologic and hydrologic information to define injection pattern areas, quantify hydrologic parameters (e.g., hydraulic conductivity, porosity, hydraulic communication patterns), develop hydrologic monitoring plans, and define baseline groundwater quality.

As part of the hydrologic testing, monitoring wells would be installed within and around the mine unit (**Figure 2-4**). Once monitoring wells were installed, aquifer testing would be conducted. Results of the testing would be submitted to WDEQ-LQD prior to mine unit development. Monitoring wells also would be installed within the mine unit and used to monitor the mine unit throughout operation and restoration of the unit (see **Appendix A, Figure A-1** for a typical mine unit pattern installation). The combination of

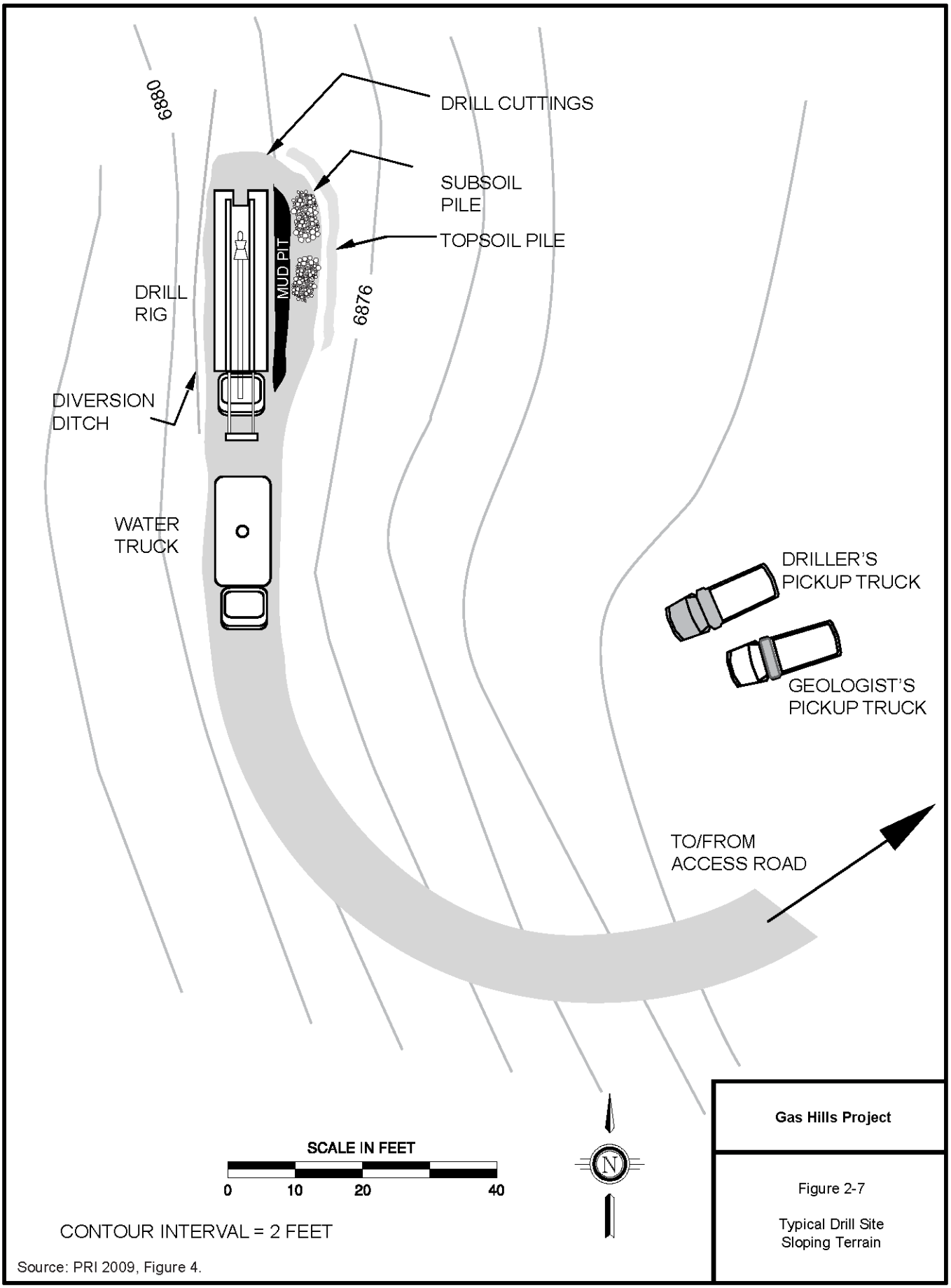


Source: PRI 2009, Figure 3.

Gas Hills Project

Figure 2-6

Typical Drill Site
Flat Terrain



Source: PRI 2009, Figure 4.

Gas Hills Project

Figure 2-7

Typical Drill Site Sloping Terrain

perimeter monitoring wells and internal mine unit monitoring wells would allow for the collection of data to assess the uranium extraction activities and as an early indicator of potential excursions.

Surface disturbance caused by installation and completion of wells is described in the next section. Perimeter monitoring well disturbance would be similar to that caused by other types of wells but would include a 2-track access road to provide access to each well within the well ring surrounding each mine unit for short-term installation activities and long-term routine sampling. Perimeter monitoring well location and spacing would be determined using technically sound methods which could include, but not be limited to: hydrologic modeling; delineation drilling data; gradient consideration; dispersivity of recovery fluids; or the calculated operational flare and calculated excursion recoverability within 60 days. The density and spacing of perimeter monitoring wells would be determined for each mine unit during the detailed hydrologic testing of each mine unit. For the purposes of this analysis, the BLM has assumed that perimeter monitoring wells would be located approximately 400 feet outside of each mine unit boundary, and would be located approximately every 400 feet along that perimeter (**Figure 2-4**). Additionally, to calculate the estimated surface disturbance for perimeter monitoring wells by mine unit, each well would be assumed to be constructed within an 18-foot disturbance, and operated within a 10-foot disturbance for 2-track roads along the perimeter (**Table 2-1**).

2.3.2.3 Well Construction

An ISR development includes 3 types of wells; injection, production, and monitoring. **Appendix A, Figure A-1** illustrates a typical mine unit pattern installation. Topsoil from drill holes and drilling mud pits would be salvaged and placed in short-term stockpiles. Wells would be drilled and installed using truck-mounted rotary drilling rigs and water trucks. After an initial borehole is completed and the location determined to be viable for ISR, each well would be completed by expanding the hole to at least 3 inches larger than the outside diameter of the casing from the surface to near the top of the uranium ore zone. The hole would be cased with a polyvinyl chloride, fiberglass, or steel well casing that would extend from the top of the ore zone to approximately 2 feet above ground level.

The casing would be grouted in place with sealing material (e.g., cement slurry). The sealing material would be pumped down through the casing and up the space between the wall of the drilled hole and the casing (annulus) of the well. The well casing would be pressure sealed and secured in place, and the sealing material allowed to cure. All wells would be constructed in such a manner to maintain well integrity and ensure that the well annulus is sufficiently sealed to prevent communication from the production zone to overlying and underlying aquifers penetrated by the well. See **Figure 2-8** for a cross section of a typical completed injection, production, and monitoring well.

Wells and associated facilities would require fencing. Similar to delineation drilling, well construction would include the use of temporary drilling mud pits. These drilling mud pits would be enclosed using "hog panels" consisting of 4 feet high by 16 feet wide rigid wire grid fence panels wired to steel T-posts. The panels would completely surround each mud pit to exclude animals and people from the drilling mud pit.

For the purposes of analysis in this EIS, surface disturbance as a result of well construction within the mine unit is captured within the total acreage of the mine unit, all of which is assumed to be disturbed during construction. See **Table 2-1** for these acreages as well as estimated acreage impacts from operations.

2.3.2.4 Access Roads, Header Houses, and Underground Utilities

Access roads within the mine units would provide access to the wells and supporting facilities inside each unit. Pipelines within the mine units would convey fluids between the wells and header houses and buried electrical lines within the mine units would provide necessary power to the facilities. The final location and number of header houses, access roads, and underground utilities within mine units would be determined based on results of delineation drilling and location of wells and support facilities.

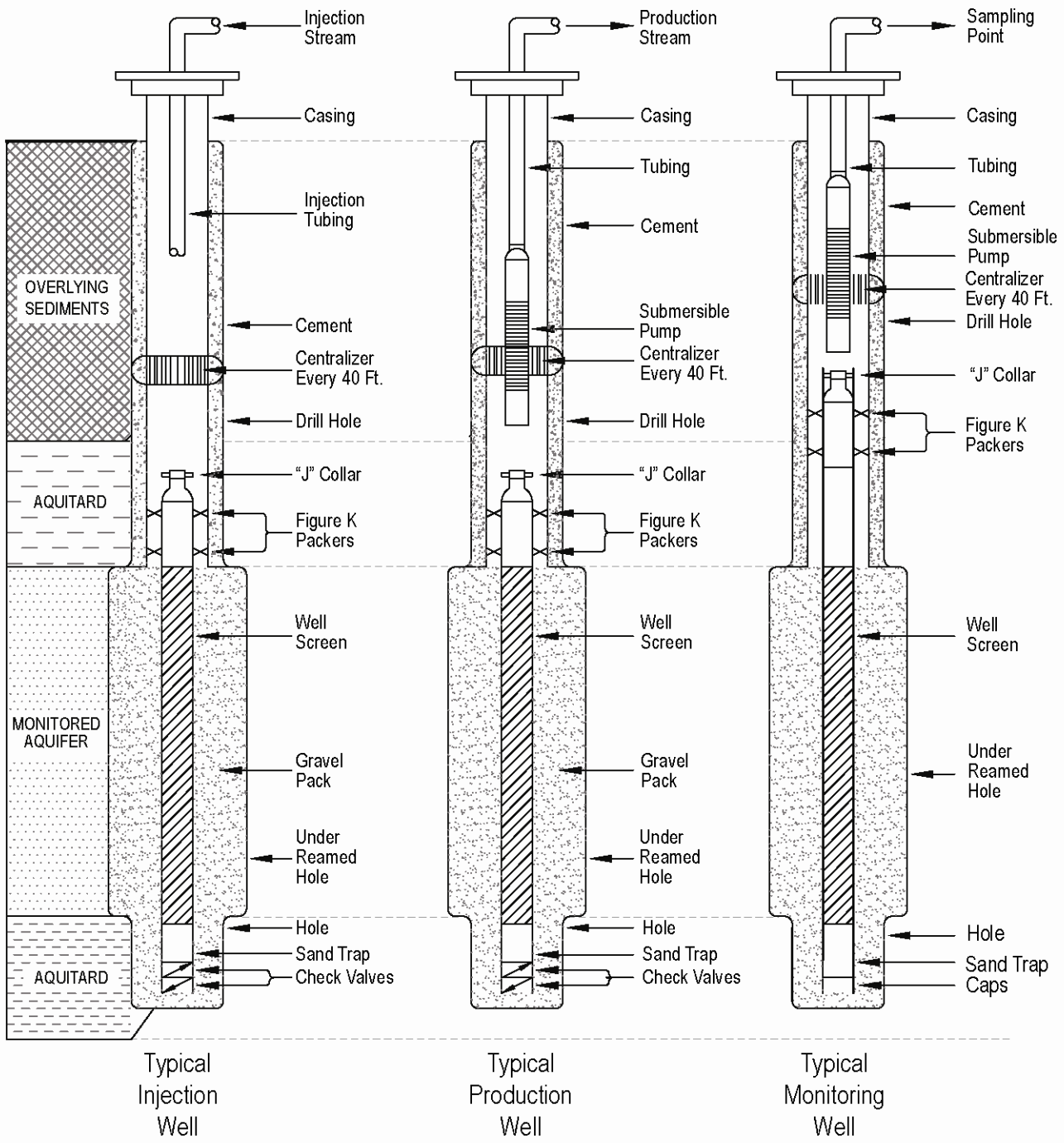


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Figure 2-8

Typical Well Cross Section

Source: PRI 2009, Figures OP3-9, OP3-8, and OP3-10.

Appendix A, Figure A-1 illustrates a typical mine unit pattern installation. Similar to wells, acreage impacts from the construction of access roads and underground utilities within mine unit boundaries are captured by the overall acreage of the mine unit (**Table 2-1**). All mine unit roads would be either light use 2-track roads with a 10-foot width and a speed limit of 10 mph or secondary roads with a 15-foot width and a 30 mph speed limit.

Fluids would be conveyed between the satellite facility and mine units through buried pipelines to small central fluid distribution buildings called header houses within each mine unit where oxidant would be added to the injection fluid. Each header house would support approximately 20 production wells and 40 injection wells. ISR fluids extracted from production wells would flow back through the header houses to the satellite facility for treatment through a second set of buried pipelines. For an average production rate of 1 million pounds per year, 7 to 8 header houses and associated wells would be installed during a year.

While the construction disturbance acreage of the header houses would be captured within the overall mine unit acreage, disturbance remaining during operations would be approximately 12 feet by 25 feet for each header house (**Table 2-1**).

2.3.2.5 Interim Reclamation

Interim surface reclamation would occur after mine unit construction, to stabilize the disturbed soils during operations. Disturbed surfaces not used during mine unit operation for roads, header houses, or aboveground power lines would be scarified and contoured, if necessary, followed by topsoil placement and seeding with an approved seed mix.

Areas that have been compacted would be scarified, ripped, and/or disked as necessary to relieve the compaction and prepare for topsoil placement. Where necessary, the surface would be graded and contoured to approximate original contours and to blend with the surrounding topography. Topsoil would be placed in a single lift to avoid compaction. On steep slopes, topsoil would be placed along the contour.

The BLM-approved seed mix would reestablish a vegetative cover consistent with the existing land use of livestock grazing and wildlife habitat. Seeding would be conducted during the first available seeding window or during spring or fall using a pitting and seeding method, appropriate for arid rangelands. Other seeding methods may be used in limited areas where the pitting and seeding method would change surface water flow. After interim reclamation, noxious weeds would be controlled as needed by annual spraying by a certified applicator using a registered herbicide, typically in late spring or early summer, or as advised by the herbicide's application instructions. Areas sprayed could include road cuts and fills, areas around buildings and fences, and isolated areas within recently constructed mine units.

The surface disturbance for wells generally would be reclaimed and seeded each year prior to disturbance associated with the following year's construction. Reclamation of longer term disturbance associated with header houses and access road would not occur until after cessation of mining activities. The majority of lands within the mine unit would have undergone interim reclamation prior to uranium production.

The uranium processing and mine unit facilities would be fenced to exclude sheep and cattle from damaging or otherwise interrupting production infrastructure and activities. Processing and mine unit fencing would be constructed according to BLM Handbook H-1741-1 and WDEQ-LQD Guideline 10 to restrict livestock but allow wildlife access, including large game. The evaporation ponds would be fenced to prevent both livestock and large game animals from accessing the ponds. Fencing also would be installed to protect vegetated areas following interim reclamation occurring outside of mine units. All reclaimed areas would remain fenced for a period of at least 2 years or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization. Fencing

would be removed after reclamation standards, described in Section 2.3.6, Final Project Reclamation and Decommissioning and Section 2.3.8, Existing Monitoring Plans, were met.

2.3.3 Mine Unit Operation

Mine unit operations would begin after construction of the first mine unit is completed or a portion of the mine unit sufficient to commence operation is completed. Once operations commence, they would continue on a 24 hour per day, 365 day per year basis until final closure. In addition to any BLM requirements, mine unit operations would be conducted under the jurisdiction of the WDEQ-LQD and the U.S. NRC.

2.3.3.1 In-situ Recovery

ISR involves the use of conventional water wells and a leaching solution, called a lixiviant, to extract the economic mineral from the geologic formation in which it occurs without physically removing the ore-bearing formation. The lixiviant consists of: 1) native groundwater to which has been added an oxidant, such as oxygen or hydrogen peroxide, to make the uranium soluble in the groundwater; and 2) a complexing ion, such as carbon dioxide or sodium bicarbonate, to which the uranium combines allowing it to be carried in groundwater pumped from the subsurface.

The lixiviant would be injected into the uranium-bearing layer through a series of injection wells. The lixiviant causes the uranium to go into solution with the native groundwater. The uranium-bearing groundwater would be recovered by pumping from production wells located adjacent to the injection wells. The uranium laden groundwater would be conveyed through buried pipelines to a surface ion-exchange system at the satellite facility. The uranium in solution attaches to ion-exchange resin beads, removing it from the groundwater. After the uranium has been removed, the majority of the water would be recycled back to the injection wells where the uranium extraction process would continue. The ion-exchange resin loaded with uranium would be transported to Cameco's Smith-Ranch Highland processing plant for further processing into a stable uranium concentrate powder (yellowcake).

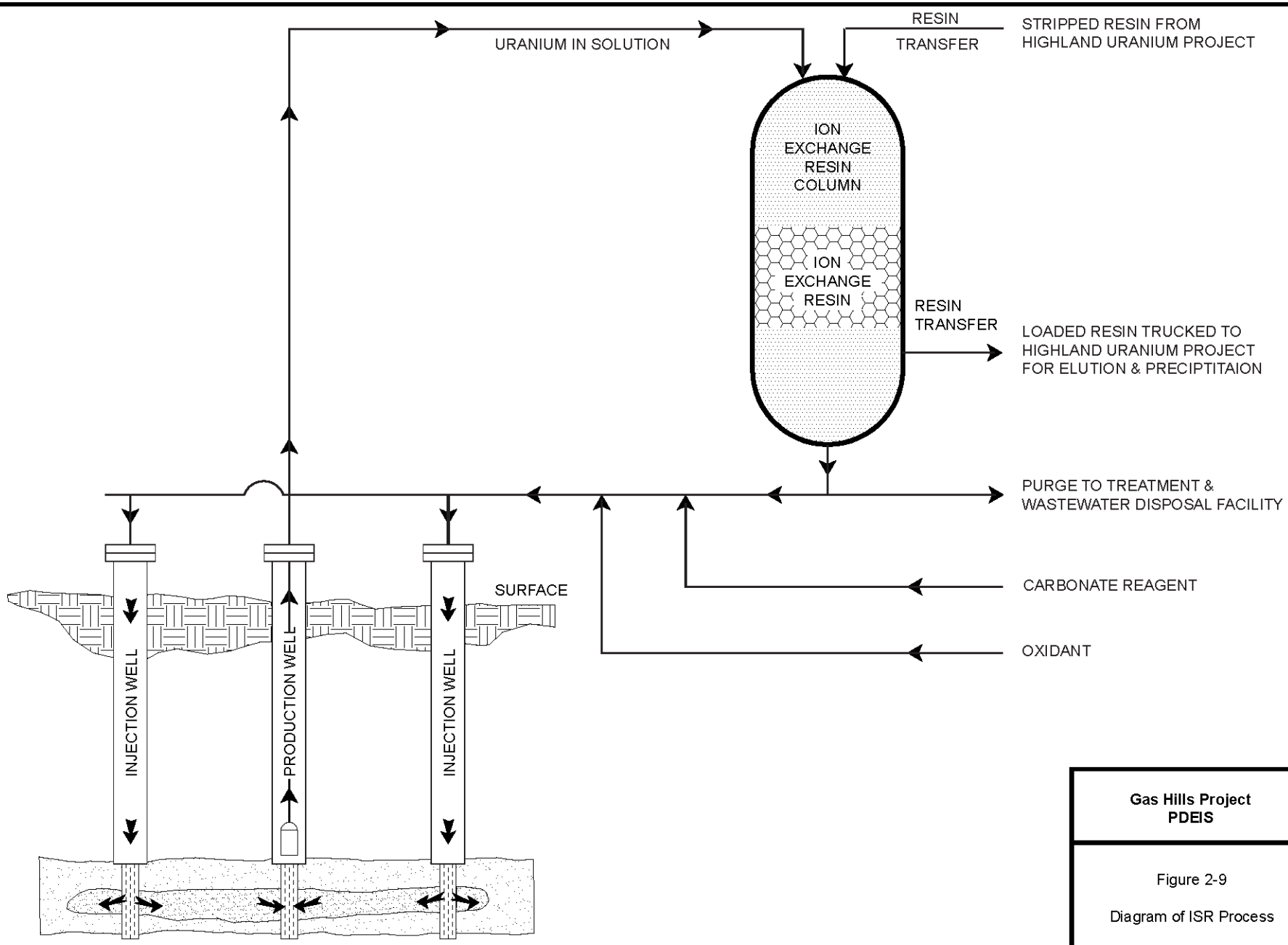
A schematic diagram of the ISR process is presented as **Figure 2-9**. After the economic recovery limit of a production zone has been reached, lixiviant injection would stop, and groundwater restoration of the production zone would start. Groundwater restoration involves returning the affected groundwater within the production zone to its pre-operational baseline water quality meeting the requirements of U.S. NRC and WDEQ-LQD rules and regulations, and is discussed in Section 2.3.5, Mine Unit Restoration and Reclamation, of this document.

A limited (approximately 1 percent) purge or "bleed" volume of water would be removed during the ISR process to maintain an inward groundwater flow within each mine unit. The result of this over-pumping would be creation of small cones of depression centered on production wells within the mine unit. These cones of depression would collectively prevent both injected chemicals and leached ore from migrating into the area surrounding each mine unit. Bleed water would be disposed of as waste water as described in Section 2.3.1.2, Waste Management.

2.3.3.2 Monitoring and Reporting

Unintended spread of lixiviant beyond the boundaries of the mine unit within the groundwater is called an excursion. Excursions could occur horizontally within the uranium-bearing layer (lateral movement of lixiviant away from the production zone), or vertically (lixiviant crossing less permeable confining strata and migrating into aquifers above or below the producing zone).

U.S. NRC licenses and WDEQ permits require periodic testing of water from monitoring wells for early identification of excursions. Monitoring wells would be located horizontally outside of the mine unit and within the production zone, and vertically above and below the production zone in adjacent aquifers, based on a design approved by WDEQ. Water samples would be collected from monitoring wells at least



Source: PRI 2009, Figure 2.

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Figure 2-9

Diagram of ISR Process

every 2 weeks during operation to test for excursions of lixiviant-bearing solutions. In addition, mechanical integrity testing would be performed before a production well is brought on-line and every 5 years during operation, to verify the well casing has no leaks. Should leaks or excursions be identified and confirmed, Cameco would be required to correct the excursion using methods approved by U.S. NRC and WDEQ. Corrective actions could include adjusting the rate of injection and pumping of lixiviant-bearing solutions, establishment of capture wells to limit any movement of the excursion, and cessation of ISR activities in the mine unit. Selection and approval of corrective actions to manage excursions would be within the jurisdiction of the U.S. NRC and WDEQ, rather than the BLM.

2.3.3.3 Transportation

Primary access to the GHPA would be either via State Highway 136 from Riverton or by Fremont County Road 212 from Waltman. Ion-exchange resin loaded with uranium would be transported to Cameco's Smith-Ranch Highland processing plant for stripping and processing into yellowcake. The stripped resin would be transported back to the GHPA for reuse. Transportation of resin (including container and vehicle specifications) would be conducted under the jurisdiction of U.S. NRC and the USDOT. Cameco estimates that, during the period of uranium recovery operations, 1 truck would make the roundtrip once per day with approximately 500 cubic feet of resin. The interstate highway, U.S. highways, and state highways are maintained year round.

Up to 20 deliveries of materials supporting the Project (e.g., sodium bicarbonate, carbon dioxide, oxygen, hydrochloric acid, or propane) would occur per week during operations. Commercial delivery services would provide general shipping services an estimated 3 times per week. In addition, traffic would include up to an estimated 23 heavy trucks per day and 54 light trucks per day, generally for employees and construction workers.

County and private roads could be impassable or closed during inclement weather. On-site storage capacity for raw materials and product would be constructed to cover 7 consecutive days of road closures. Should roads remain impassable for that period or longer, Cameco would contract with road maintenance crews to provide passage.

2.3.4 Personnel/Work Force

The Project would employ a mix of full-time personnel and contractors throughout the life of the mine. Approximately 20 full time employees and 20 contractors would be hired in the first year of the Project. Contractor personnel would include employees of companies conducting work at the site (typically drilling and construction) under contract to Cameco, and would remain at the same level through year 20. The Project would employ approximately 65 full-time workers from year 2 through year 19, tapering down to 50 in years 20 and 21, and 40 full-time personnel through the final year of the Project. It is likely that a majority of the workers would live in Riverton or Casper. The Project would contribute to public revenues through payment of taxes to federal, state, and local governments, including income taxes, mineral severance taxes, property taxes, and sales taxes.

2.3.5 Mine Unit Restoration and Reclamation

Final reclamation of mine units generally consists of 2 major activities:

- Groundwater restoration; and
- Final mine unit surface reclamation.

Mine unit groundwater restoration and surface reclamation would occur while construction or operations occur in other mine units. Once the economic recovery limit of any mine unit has been reached, uranium recovery operations would cease, and groundwater restoration would commence. After groundwater within a mine unit has been restored to pre-operational baseline water quality or an alternative concentration limit approved by the U.S. NRC, removal of mine unit infrastructure and final surface

reclamation would be implemented. Groundwater restoration would be approved under the jurisdiction of WDEQ-LQD and the U.S. NRC while surface reclamation would be conducted under the jurisdiction of WDEQ-LQD, U.S. NRC, and the BLM. Activities at each mine unit, from construction through operation and the end of final surface reclamation, is estimated to take 10 to 13 years, based on currently estimated initial and maximum production rates and on the anticipated time frame for groundwater restoration. Production rates would be adjusted in response to actual mine unit well flows, uranium recovery rates, the market demand for uranium, and the actual rate of groundwater restoration. These adjustments potentially would affect the estimated time to final surface reclamation.

2.3.5.1 Groundwater Restoration

Restoration of groundwater to pre-mining quality would be a sequenced, phased process using Best Practicable Technology (BPT). The goal of groundwater restoration would be to return the affected groundwater within the production zone to pre-operational baseline water quality. For affected groundwater outside the production zone, an evaluation would be performed on a well-by-well basis. Additionally, water outside the aquifer exemption boundary must be protected to applicable USEPA maximum contaminant levels per 40 CFR 141, as amended July 1, 2001 DEQ Rules and Regulations Chapter 11, Section 5(a)(ii)(B) through (D).

Groundwater restoration would use the existing mine infrastructure and would not require additional construction. Production wells would be switched to groundwater restoration, and water flow would be conveyed through existing piping and header houses. Groundwater restoration would be accomplished using several methods such as groundwater sweep, reinjection of groundwater treated by RO, bioremediation, or addition of reducing chemicals. Groundwater restoration is currently estimated to take 4.5 to 7.5 years to achieve within a given mine unit; however, restoration activities would continue until stability is achieved and regulatory concurrence has been granted by WDEQ-LQD and U.S. NRC.

<u>Methodology</u>

At the beginning of groundwater restoration, the wells sampled for baseline water quality would be resampled and analyzed to characterize an "end of mining" water quality average. The wells would be sampled annually and analyzed for pH, total dissolved solids (TDS), cations (calcium, magnesium, sodium, potassium, ammonia, barium, strontium), and anions (carbon trioxide, bicarbonate, sulfate, chloride, fluoride, nitrogen trioxide, silicon dioxide). To track the progress of restoration, the wells also would be sampled monthly and analyzed for conductivity, chloride, and uranium during periods of active restoration.

A combination of the following groundwater restoration tools may be necessary to return the quality of water to pre-operational baseline conditions utilizing BPT, including the following.

1. **Groundwater Sweep:** Water would be pumped from the wellfield to the processing plant through all production and injection wells without reinjection. Uncontaminated native groundwater flows into the ore body, thereby flushing the contaminants from areas that have been affected by the uranium recovery process. Groundwater produced during the sweep phase would initially contain uranium and other contaminants mobilized during the uranium recovery phase, but would decline gradually with time. Groundwater produced during the sweep phase would be treated using RO technology with the treated water being recycled and used as lixivant in the remaining mine units, and the brine being disposed of by evaporation or deep well-disposal by injection.
2. **Groundwater Treatment and Re-injection:** Groundwater pumped from the wellfield would be treated. The filtered water would be re-injected into the wellfield, further reducing lixiviant volumes and ion concentrations. The RO capacity would be sized to meet the water needs for the restoration process.
3. **Biological Reductant and/or Chemical Reductant Treatment:** Biological nutrients (e.g., molasses or ethanol) or a chemical reductant (e.g., sodium sulfide) would be added to water

being pumped through the formation to create a reducing environment, so the remaining dissolved uranium would precipitate out of solution.

4. **Chemical Treatment for pH (if required):** Final adjustment of pH may be required to assist in immobilizing certain ions, particularly metals. Adjustment of pH would be achieved by adding chemicals such as potassium hydroxide or sodium hydroxide into the uranium production zone during the later stages of groundwater restoration to return the aquifer to the original pH.

During operations and groundwater restoration, the wastewater treatment would take place at the Carol Shop or the second satellite facility.

The proposed groundwater restoration methodology is based on current, industry-wide practices and innovations. As groundwater restoration technology continues to evolve, alternative restoration methods that could accelerate and/or improve groundwater restoration success would be considered and evaluated. Regulatory approval from WDEQ-LQD would be obtained prior to initiating any alternative restoration method.

Stability Monitoring after Groundwater Restoration

Following concurrence that groundwater restoration has been achieved in a particular mine unit by WDEQ-LQD, groundwater quality would be monitored for an additional 12-month period to ensure that the restored groundwater quality remains stable. Stability monitoring would involve collection of samples from all monitoring wells at the beginning of the stability period, collection of samples from monitoring wells within the production zone once every 2 months, and collection of samples from perimeter monitoring wells on a monthly basis.

At the end of the stability period, monitoring data would be evaluated to determine the success of the groundwater restoration effort. Cameco would provide a restoration report to WDEQ-LQD and U.S. NRC containing the data evaluation and an analysis of the restoration effort. The agencies would review the reports and determine whether restoration was successful, whether more stability sampling would be required, or whether additional active restoration would be required.

2.3.5.2 Final Mine Unit Surface Reclamation

Once Cameco has restored the groundwater within a mine unit to target water quality approved by the U.S. NRC and WDEQ-LQD, final surface reclamation would be implemented. Wells would be plugged and abandoned, followed by the removal of subsurface infrastructure (i.e., buried pipelines, power lines, and other utilities) and surface facilities (i.e., aboveground power lines, header houses, and roads) and minor site grading. This activity would involve re-disturbing the entire mine unit surface. Removal of infrastructure would then be followed by final surface reclamation and revegetation operations. Reclamation of mining-related surface disturbances in any mine unit would be implemented, and should be trending towards reclamation success within 2 years following approval by the WDEQ-LQD and U.S. NRC of groundwater restoration in that mine unit.

All wells would be abandoned in accordance with WDEQ-LQD Rules and Regulations. Wells would be sealed from bottom to top with an approved abandonment fluid (e.g., cement slurry). The soil around the well casing would be excavated to at least 2 feet below ground surface, the casing would be cut off, and a concrete plug would be placed on top of the casing. The excavated area around the abandoned well would be backfilled with the excavated material to the original surface and seeded with the approved seed mix.

2.3.6 Final Project Reclamation and Decommissioning

Following completion of mining and groundwater restoration activities at all mine units Cameco would decommission and reclaim all facilities and other mining-related disturbance outside of the mine unit boundaries. The goal of this activity would be to return those surface areas affected by ISR activities to a

condition which would support the pre-mining land use of livestock grazing and wildlife habitat. Reclamation activities (i.e., decommissioning, grading, topsoil application, and seeding) for all mining-related surface disturbances would be completed within 2 years following approval of final groundwater restoration within the GHPA. Final reclamation would be deemed complete and successful based upon criteria detailed in Section 2.3.9, Applicant-committed Environmental Protection Measures and in reclamation standards outlined in the Lander RMP (BLM 1987). All reclaimed areas would remain fenced for a period of at least 2 years, or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization. The fencing would not be removed until the BLM and WDEQ-LQD agree that the revegetated areas are ready for livestock grazing.

Those facilities requiring decommissioning and removal following the completion of groundwater restoration of the entire Project include, but are not limited to:

1. Buildings and structures, including the Carol Shop facility and the additional satellite facility (if constructed);
2. Process and water treatment facilities housed within these structures including tanks, piping (aboveground), pumps, and related equipment;
3. Buried piping including piping between mine units and process and water treatment facilities, and piping between the Carol Shop facility or the additional satellite facility and the evaporation ponds or wastewater disposal well(s);
4. Evaporation ponds and/or wastewater disposal well(s);
5. Overhead and buried power lines; and
6. Access roads.

Prior to final reclamation, all radiologically contaminated portions of buildings, process vessels, and other structures and affected areas would be decontaminated to U.S. NRC unrestricted release standards or, if decontamination is not possible, removed to a disposal facility licensed by the U.S. NRC to receive such material. Radiological surveys would be conducted following radiological decontamination to verify that areas affected by the Project meet U.S. NRC decommissioning criteria. Note that there are areas that currently have elevated radiological levels, namely the previously mined areas and their associated access roads.

Prior to demolition of buildings and structures within the GHPA (including the Carol Shop facility, satellite facilities, and pump stations), all equipment would be removed. Any contaminated materials would be decontaminated or removed for disposal at an U.S. NRC-licensed facility. Buildings and structures would be dismantled and removed from the GHPA either for disposal at an appropriately licensed solid waste facility or for salvage.

All buried piping would be removed from the GHPA. Contaminated materials would be disposed at an U.S. NRC-licensed facility. Non-contaminated material would be disposed at an appropriately licensed facility and/or would be removed for salvage. Removal of piping would re-disturb pipeline ROWs which then would be reclaimed and seeded.

Upon completion of use, and evaporation of excess liquid, solid wastes contained in the evaporation ponds, as well as the primary liner, would be removed and disposed of at an U.S. NRC-licensed disposal facility as described in Section 2.3.1.2, Waste Management. The underlying leak detection system and secondary liner would be surveyed and tested for contamination. Any portion of the leak detection system, secondary liner, and/or underlying materials that did not meet U.S. NRC decommissioning criteria would be excavated and removed for disposal at an U.S. NRC-licensed facility.

Portions of the leak detection system which met U.S. NRC decommissioning criteria would be covered with a minimum of 4 feet of overburden and topsoil and reclaimed in place. Any uncontaminated solid

waste material which could be detrimental to site reclamation would be removed and disposed of at an appropriately licensed facility. Following cleanup of the site and removal of contaminated materials, the evaporation ponds would be graded to their approximate original contour. Grading would include the replacement of material excavated during the construction of the evaporation ponds. Topsoil would then be replaced and the area reclaimed to the final reclamation standards presented in the applicant-committed environmental protection measures.

All buried and overhead power lines would be removed from within the GHPA. Removal of buried lines and power poles would re-disturb power line ROWs which then would be reclaimed and seeded.

Prior to reclamation, all roads would be surveyed for radiological contamination in excess of radiological levels documented as pre-existing baseline conditions. Any contamination resulting from the ISR operation would be cleaned to appropriate U.S. NRC standards and the contaminated material disposed of at an U.S. NRC-licensed facility. Following decontamination, roads would be ripped and/or disked to relieve compaction. Excess imported gravel would be removed. Culverts would be removed and pre-mine drainages reestablished. All roads and ditches to be reclaimed would be graded and contoured to blend with the surrounding terrain.

Those portions of roads utilized for access to the site, facilities, and mine units, including the AML road, the Carol Shop Road, and constructed access roads, would be reclaimed unless landowners and lessees request that the roads be left for future access and accept the responsibility for their long-term maintenance and ultimate reclamation.

2.3.7 Temporary Closures

U.S. NRC regulations allow for the placement of uranium ISR facilities on standby for up to a 24-month period. If operations have not resumed by the end of the 24-month period, Cameco would be required to proceed with Project decommissioning unless a request for a time extension was submitted to and approved by the U.S. NRC. Temporary closures during the operational life of the Project, while not expected, could occur under specific economic conditions. This section discusses the sequence of activities that would take place in the event of a temporary closure.

An economic downturn in the uranium market that would render the Project unprofitable would cause a temporary cessation of uranium production. In addition, if Cameco were to decide to end the Project early, activities at the mine could not stop immediately. The following actions would take place:

- Delineation drilling would cease and surface disturbances would be reclaimed in accordance with the applicant-committed environmental protection measures in Section 2.3.9, Applicant-committed Environmental Protection Measures;
- Mine unit development and construction would cease;
- Producing mine units would continue in the production mode until the uranium resource was depleted, at which time they would proceed into the groundwater restoration phase;
- Mine units in groundwater restoration would continue in that mode until regulatory requirements for restoration was achieved; and,
- Once groundwater restoration was completed and approved, surface reclamation and decommissioning would be completed on a mine unit by-mine unit basis until all mine units were decommissioned.

Once these activities were completed, Cameco would make a business decision as to whether to proceed to final reclamation or to keep the main injection/recovery trunk lines and uranium recovery facilities in place in anticipation of a future production restart. A decision to keep these facilities in place for an extended care and maintenance period would result in the following actions by Cameco:

- Main trunk lines to the uranium recovery facility would be drained and the excess water would be treated and disposed of.
- Open ends of the pipelines would be sealed, and manholes would be secured from access by securing the lids to the manholes and locking the access hatches.
- Plant equipment, including reagent tanks, would be drained, decontaminated, and protected for future use.
- Interior building surfaces would be decontaminated and cleaned.
- Solids would be removed from the evaporation ponds and properly disposed, and the pond liner surfaces would be decontaminated and cleaned.
- Fuel storage tanks would be removed from the site and the storage areas would be reclaimed.
- Buildings and ponds would be secured from public and animal access using fences and by securely locking access doors.
- Facilities would be inspected on a monthly basis. The inspected areas would include restricted access to radiological areas, evaporation ponds, mine units, and perimeter fences.
- Any discovered breach of site infrastructure would be reported to the proper regulatory and law enforcement authorities by Cameco. Potential hazards resulting from the breach would be assessed, documented, and reported as required. The breached area would be re-secured as necessary.
- A remote alarm and monitoring system would be considered if the technology was determined practicable at such a remote location.

2.3.8 Existing Monitoring Plans

A monitoring program has been developed by Cameco and approved by WDEQ-LQD and U.S. NRC to monitor the effects of the Project. The objectives of the monitoring program would be to: 1) demonstrate compliance with the monitoring plan and ensure compliance with other state and federal regulations and laws; 2) provide early detection of potential problems; and 3) supply information that would assist in directing corrective actions should they become necessary.

The Project surface and groundwater monitoring programs for pre-operational, operational, and post operational monitoring are detailed in the Operations Plan (PRI 2009). A detailed surface and groundwater sampling and analysis plan also is part of the LQD requirements. The following sections summarize the major elements of these monitoring plans.

<u>Surface and Groundwater Monitoring</u>

The predominant natural surface water flowing through the permitted area is West Canyon Creek (WCC), which is considered to be a perennial stream. Although the spring flows year round, only about 1.7 miles of the Creek flows on a perennial basis. With the exception of WCC, most drainages throughout the property are intermittent and ephemeral in nature, and flow only in response to spring run-off or occasional thunderstorms.

Baseline surface water conditions would be characterized based on samples collected from 6 surface water locations prior to construction of mine facilities: WCC-1, WCC-2, WCC-3 on WCC; Cameron Spring; and 2 locations in Fraser Draw denoted as WFD and EF. Results from these locations would be used to compare results from monitoring during the life of the Project.

Three surface water sites and 1 groundwater site would be routinely monitored during the life of the Project as part of the area-wide monitoring program. These sites would include the following:

- Cameron Spring Reservoir which is located south and up-gradient of the proposed Mine Unit 1 in the SESE Qtr/Qtr of Section 2, T32N, R90W. Monitoring would include discharge rate and water quality from the spring;
- Stock Pond in Section 32, a small constructed pond near the northern end of proposed Mine Unit 1, in the SWNE Qtr/Qtr of Section 32, T33N, R89W. Monitoring would include quarterly grab samples that would be analyzed for conductivity, pH, natural uranium, and radium-226;
- WCC which flows through proposed Mine Unit 4 has 2 established surface water monitoring stations. Monitoring would include quarterly grab samples at the start of Mine Unit 4 construction; and
- The current drinking water supply well for the Carol Shop facility would be plugged and abandoned due to high radium concentrations. Cameco intends to drill a new supply well for the Carol Shop facility under a separately permitted action, and as permitted by the Wyoming State Engineer's Office. Currently, Cameco anticipates the water would come from formations below the Wind River Formation, either from the Nugget Sandstone formation, or from a formation within the Chugwater group. Monitoring of the new well would follow the requirements of the permit and the U.S. NRC license stated for the existing drinking water supply well.

Additional monitoring wells would be installed as part of mine unit development and would include perimeter wells that surround and monitor the mine unit as well as wells to monitor overlying and underlying aquifers. A network of regional groundwater monitoring wells already exists at the GHPA that was previously sampled and measured to establish pre-mining baseline groundwater quality and limited static groundwater elevations.

Post-operational Vegetation Monitoring

Project monitoring also would include post-operational vegetation monitoring. The reclamation goal within the GHPA would be to return the land to a condition that would sustain the pre-mining land use of livestock grazing and wildlife habitat. The success of revegetation in meeting the land use goal would be assessed prior to application for bond release by using the Comparison Area (COMA) method as described in State of Wyoming regulations. A COMA is defined as a land unit which is representative, in terms of physiography, soils, vegetation, and land use history, of a plant community where the pre-mining total vegetation cover and species diversity has not been collected, or where the area to be affected is small and incidental to the operation. The representative nature of each COMA is validated by a subjective field reconnaissance of the site or by subjective evaluation of the vegetation data generated by a sampling program. Post-mining quantitative data from the COMAs would be directly compared, by standard statistical procedures, to data from a reclaimed vegetation type when evaluating revegetation success for full bond release.

Revegetation would be considered successful when, at the end of the bonding period, the following have been demonstrated:

- Vegetation species of the reclaimed land are self-renewing under natural conditions prevailing at the site;
- Total vegetation cover of perennial species (excluding noxious weed species) and any species in the approved seed mix is at least equal to the total vegetation cover of perennial species (excluding noxious weed species) on the area before mining;
- Species composition and diversity are suitable for the approved post-mining land use; and
- The above criteria are achieved during 1 growing season, based on observations collected no sooner than the fifth full growing season following reclamation.

Further details of vegetative success criteria are listed in Section 2.3.9, Applicant-committed Environmental Protection Measures.

Air Monitoring

Cameco would maintain a continuous air monitoring program at locations upwind and downwind relative to the permit boundary in order to ensure compliance with U.S. NRC regulations 10 CFR 20.1301, 20.1302, and 20.1501. The air monitoring program would include passive gamma and radon monitoring devices. Air particulate air sampling also would be conducted.

Wildlife Monitoring

Wildlife also would be included as a component of monitoring at the mine. Wildlife surveys were conducted in 1992, 1993, 1994, 1996, 1997, 1999, and 2007 and provide baseline information. These annual wildlife surveys were reinitiated by Cameco in 2009, 2010, and 2011, and reports were provided to the WDEQ and the BLM.

A Wildlife Monitoring Plan was prepared in consultation with and approved by the BLM, the lead agency for Project-related wildlife issues, as well as the WGFD and the USFWS. The plan describes the methodology and frequency of annual monitoring as well as listing the specific species to be monitored. The plan would be reviewed annually with the BLM to address any necessary changes. The most recent update was submitted for BLM approval on July 22, 2011.

Annual surveys that are part of the revised monitoring plan include: occupied sage-grouse leks within 2 miles of the GHPA, active raptor nests within 1 mile of the GHPA, mountain plover presence/absence surveys in known habitat within 0.25 mile of the GHPA, and surveys for burrowing owl occurrence and sign. Opportunistic sightings of other wildlife species also would be included in annual reporting. After construction of the evaporation ponds, Cameco would monitor potential waterfowl activities in and around the ponds and would be required to report any migratory bird losses.

2.3.9 Applicant-committed Environmental Protection Measures

Applicant-committed environmental protection measures included in Cameco's PoO (PRI 2011a) or Mine Permit Application (PRI 2009) that would avoid, minimize, or mitigate impacts due to the Proposed Action are provided in the following sections.

General Construction

- Both primary and secondary access roads would use culvert crossings at drainages.
- Topsoil would be placed in a single lift to avoid compaction. On slopes of 4:1 (horizontal to vertical) or steeper, topsoil would be placed along the contour. Topsoil would not be placed under excessive wet, dry, or frozen ground conditions which would cause excessive clod or frost chunks to form. Topsoil thicknesses would reflect the approximate thicknesses of topsoil originally available at the locality being reclaimed. All salvaged topsoil would be utilized for reclamation purposes.
- Topsoil information would be provided to WDEQ-LQD, together with proposed stripping depths, as part of the Hydrological Test Proposal for each mine unit. In those cases where topsoil stripping would be necessary, such as a major road or building site, site-specific topsoil thickness and suitability evaluations would be performed utilizing either drill borings or backhoe excavations. Topsoil stripping depths would be based on visual observation and the results of chemical analyses, and would be field staked prior to salvage operations. Topsoil depth and suitability determinations would be made by persons qualified by education and/or training to make such determinations. The maximum stripping depth would be 12 inches for all excavations, except for mud pits and evaporation pond sites, which would have all suitable material salvaged and stockpiled.
- Typical long term topsoil stockpiles would be large, contain topsoil for more than 1 year and result from the excavation of building sites, evaporation ponds, culvert crossings, and primary and secondary access roads. These stockpiles would be constructed with 3:1 or flatter side

slopes and would be seeded on the contour as soon as possible after construction using only the grass species of the BLM and WDEQ-LQD approved permanent seed mix. All long-term stockpiles would be bermed along the bottom to control sediment runoff and would be identified with highly visible signs containing the word "TOPSOIL" in letters at least 6 inches high. The signs would be placed on stockpile approach roads not more than 150 feet from the stockpile. Locations of long-term stockpiles and their volumes would be included in each LQD Annual Report.

  - The need to conduct nutrient analyses of topsoil that has been stockpiled for more than one year would be assessed prior to redistribution of the topsoil. The size and depth of the stockpile, the amount of vegetation growth present, and the length of time the topsoil was stored would be taken into consideration. Nutrient analyses would not be performed on stockpiles that were less than 5 feet thick as the microbial activity within the soil would be maintained because of the limited thickness and resultant compaction. If after two growing seasons following topsoil application and seeding, revegetation problems are identified, nutrient analyses would be performed. Should the analyses indicate a nutrient deficiency, the area would be fertilized and reseeded.

- Typical short-term topsoil stockpiles result from excavation of drill hole and well mud pits. Typically, topsoil would remain in short term stockpiles for no more than 6 months. This would allow for direct replacement of "live topsoil" on the disturbed surface. Except for small short-term stockpiles which would be constructed with gentle side slopes, the perimeter of long-term topsoil stockpiles would be bermed to control sediment runoff. Additionally, large topsoil stockpiles, such as those that would result from the excavation of large building sites and the evaporation ponds, would be constructed with 3:1 or flatter side slopes and would be seeded on the contour.
- Following completion of delineation drilling, wellfield design would locate injection and recovery wells outside the boundary of wetlands. Under the Proposed Action, wetlands temporarily could be disturbed for construction of roads. Cameco would work with the WDEQ and U.S. Army Corps of Engineers (USACE) to define jurisdictional wetlands, and comply with the Section 404 or Section 401 permitting process, as appropriate. These processes would include development of a mitigation plan.
- Aboveground facilities would be painted with low-reflectivity paints in colors that would blend with the natural environment. The BLM color chart would be consulted in selecting an appropriate paint color or colors.

<u>Mine Unit Construction</u>

- The drilling mud pits would be fenced using 4 feet high by 16 feet wide rigid wire grid fence panels wired to steel T-posts (hog panels) protect from human and animal intrusion until the contained fluid was removed or evaporated, at which time the pits would be reclaimed and the fencing removed.
- Topsoil would be separately stockpiled within the mine unit disturbance area and replaced after well construction completion.
- Pre-construction contours would be restored and reclaimed after a well was constructed.
- All areas disturbed for mine unit well, pipeline, and utility trenches would be reclaimed and revegetated as soon as possible after construction was completed.
- All fencing installed at the Project would be of a temporary nature to protect the wellfield areas during operations and to protect vegetated areas following reclamation. Fence design and specifications would follow the BLM specifications as they are the dominant land owner within the permit area.

Storm Water Management

- Sedimentation would be controlled through the use of erosion control and channel stabilizing measures such as:
  - ditches and berms;
  - conveyance channels;
  - rock/rip rap;
  - outlet protection;
  - sediment traps or basins;
  - straw bale barriers;
  - silt fence; and
  - check dams.
- All long-term topsoil stockpiles (e.g., soil removed from building areas, access roads, etc.) would be fully contained and vegetated. A containment ditch and berm would be constructed at the base of each stockpile to prevent any loss of topsoil before new vegetation could be established.
- All available disturbed areas, including topsoil piles, road cuts, etc. would be seeded with the approved seed mix at the first appropriate season, spring or fall, to control erosion and protect the topsoil resource. Should weather or other conditions prohibit disturbed areas from being seeded for more than 3 months, the area would be scarified with a disc, chisel plow, or similar apparatus, or mulched with a straw mulch crimped at a rate of 2 tons per acre, to assist in conserving the topsoil resource until seeding can be accomplished. The establishment of a temporary cover crop, such as barley, winter wheat, millet, or rye seeded at 30 pounds per acre also could be utilized to assist in protecting the topsoil resource.
- Areas with slopes greater than 25 percent would be mulched with straw mulch crimped at a rate of 2 tons per acre or planted with a temporary cover crop as soon as possible to assist in preventing erosion. Geotextile "mulched matting" and select erosion control products would be utilized on areas where erosion control and vegetation establishment is particularly difficult. BMPs would be utilized to control sediment loss from stripped and or recently topsoiled and seeded areas.
- Fuel storage areas would be managed to prevent off-site drainage to or from the area. All petroleum products stored at the site would be contained in approved and appropriately labeled aboveground containers. Secondary containment would be accomplished by berming and/or ditching the perimeter of the entire fuel storage area.
- For exposed soil areas where construction activities were temporarily ceased for a period of 28 days or more, temporary stabilization measures would be implemented. These measures could include surface roughening, cover crop plantings, mulching or erosion control blankets. Temporary erosion protection would be especially important for areas containing graded slopes, ditches, berms, and soil stockpiles. The primary method of revegetation would be the pitting and seeding method. To the extent possible, crossing perennial and intermittent drainages with drill equipment and vehicles would be avoided. If it became necessary to cross a drainage to reach a drilling site, a temporary stream crossing would be constructed at right angles to the channel with adequate embankment protection and installation of properly sized culverts. Once the drill location was reclaimed and seeded, the stream crossing would be removed and any surface damage reclaimed and seeded.
- Mobilization of the drill rig from hole to hole would be restricted to dry or frozen ground conditions.

- During active construction, qualified personnel would inspect disturbed areas, control measures, and locations where vehicles entered or exited the site, at least once every 14 calendar days and within 24 hours of the end of any precipitation and/or snow melt event which exceeds 0.5 inches. During seasonal shutdowns qualified personnel would inspect the site at least once every month, unless snow cover or frozen ground conditions exist over the entire site for an extended period with no melting conditions.

Operation

- Fences surrounding evaporation ponds would be constructed to prevent both livestock and wildlife from accessing the ponds.
- Long-term fencing would be constructed around the mine unit production facilities and processing satellites that would prevent access by sheep and cattle but still would allow wildlife access to forage (Section 2.3.2.5, Interim Reclamation).
- Mine unit fluid spills that could contaminate surface soils would be minimized through the use of proper construction and operational procedures, detection devices and alarms, and proper training of personnel.
- Cameco would monitor waterfowl activity at the evaporation ponds during operation:
  - Should it become necessary, Cameco would implement actions to remove, exclude, and deter waterfowl using methods including, but not limited to propane cannons, netting over the ponds, and brightly colored pennants.
- Proposed mitigation for raptor nests could include construction of alternate nest sites on natural features, or the erection of appropriately sized nesting platforms.
- Site speed limits of 40 mph on primary roads, 30 mph on secondary roads, and 10 mph on 2-track roads would be implemented to reduce wildlife/vehicle collisions and generation of dust.

Decommissioning

- All reclaimed areas would remain fenced for a period of at least 2 years, or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization:
  - The fencing would not be removed until the BLM and WDEQ agreed that the revegetated areas are ready for livestock grazing.
- Buildings and structures would be dismantled and removed from the Project and would be salvaged or disposed of at an appropriately licensed solid waste facility.
- Radiological surveys would be conducted following any radiological decontamination to verify that areas affected by the Project meet U.S. NRC decommissioning criteria.

Reclamation

- During final reclamation buildings, structures, well, pump stations, overhead and buried power lines, evaporation ponds, and buried piping would be removed.
- Following cleanup of the site and removal of contaminated materials, the evaporation ponds would be graded to their approximate original contour. Grading would include the replacement of approximately 56,400 cubic yards of material excavated during the construction of the evaporation ponds. Topsoil would be replaced and the area seeded.
- Following decontamination, the roads would be ripped and/or disked to relieve compaction. Excess imported gravel would be removed. Culverts would be removed and pre-mine drainages

reestablished. All roads and ditches to be reclaimed would be graded and contoured to blend with the surrounding terrain.

- All disturbed surfaces would be scarified and contoured, if necessary, followed by topsoil placement and seeding with the approved seed mix.
- Areas which were compacted would be scarified, ripped, and/or disked as necessary to relieve the compaction and prepare the sub grade for topsoil placement. Where needed, the surface would be graded and contoured to approximate original contours and to blend with the surrounding topography. In areas that were stripped of topsoil, the salvaged topsoil would be re-applied in a single lift to avoid compaction. If necessary, the replaced topsoil would be disked to create a proper seed bed. Seed bed preparation would only be performed under appropriate soil and climatic conditions.
- The seed mixture used would be comparable to mixes used on other reclamation mines in the area, and was approved by the WDEQ-LQD and the BLM in 2008. This mix was designed to establish a vegetative cover consistent with the pre-mining land use of livestock grazing and wildlife habitat. Should any approved seed varieties become unavailable or cost prohibitive, or more locally adapted species become available, reasonable substitutions could be made after prior consultation with and approved by the BLM and WDEQ-LQD.
- Final reclamation of mine units would be performed as soon as practicable after ground water restoration has been completed and approved by the regulatory agencies. Wells would be plugged and all surface structures and power lines removed.
- Compacted areas would be scarified, ripped, and/or disked as necessary to relieve the compaction and prepare the sub grade for topsoil placement. Where needed, the surface would be graded and contoured to approximate original contours to blend with the surrounding topography. In areas stripped of topsoil, the salvaged topsoil would be re-applied. If necessary, the replaced topsoil would be disked to create a proper seed bed. Seed bed preparation would only be performed under appropriate soil and climatic conditions.
- The reclamation goal at the Project would be to return the land to a condition that will sustain the pre-mining land use of livestock grazing and wildlife habitat.
- The success of revegetation in meeting the land use goal would be assessed prior to application for bond release by utilizing the COMA method as described in WDEQ-LQD Rules and Regulations Chapter 3, Section 2(d)(vi)(C) and LQD Guideline No.2-Vegetation (November 1997).
- At the time of bond release on all areas, including previously disturbed and reclaimed areas, the actual methodology to be used for evaluating vegetation success would be submitted to WDEQ-LQD at least 6 months prior to field sampling. Revegetation would be considered successful when, at the end of the bonding period, the following has been demonstrated:
  - The vegetation species of the reclaimed land are self-renewing under natural conditions prevailing at the site;
  - The total vegetation cover of perennial species (excluding noxious weed species) and any species in the approved seed mix is at least equal to the total vegetation cover of perennial species (excluding noxious weed species) on the area before mining:
  - The species composition and diversity are suitable for the approved post-mining land use; and
  - The above are achieved during one growing season, no earlier than the fifth full growing season on the reclaimed lands.

- In the unlikely event that any trees must be removed, Cameco would inventory such trees prior to removal and include that information and replacement cost in the appropriate annual report and surety revision submitted to WDEQ-LQD.
- In those areas where there were few or no noxious weeds prior to being affected by the ISR operations, Cameco would control and minimize the introduction of noxious weeds into the revegetated areas for at least 5 years after the initial seeding had taken place.
- The primary method of revegetation would be the pitting and seeding method. In limited areas where pitting and seeding would potentially interrupt surface water flow, such as incised drainage channels, areas with slopes steeper than 3:1 (horizontal to vertical) and permanent topsoil stockpiles, drill or broadcast seeding would be utilized.
- All reclaimed areas would remain fenced for a period of at least 2 years, or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization.

2.4 Resource Protection Alternative

The Resource Protection Alternative (RPA) was developed to respond to public and agency input collected during the scoping process. This alternative is similar to the Proposed Action described in Section 2.3, Proposed Action, of this document, in that it would involve the development of uranium deposits in the GHPA through implementation of the ISR process to remove uranium from the ore-bearing formation. The RPA would utilize the same processes and take place over the same time period as the Proposed Action but with the following changes implemented to reduce surface disturbance, travel to and from the GHPA, and impacts to soils, vegetation, and wildlife, as well as increase the number of workers and enhance reclamation speed and quality for the Project:

- **Annual Development Planning:** Surface disturbance and potential for soil compaction and erosion associated with construction in each mine unit would be reduced, and the potential for successful reclamation would be increased through submittal of an Annual Development Plan (ADP) to the BLM that would require delineation of specific areas to be disturbed along with procedures to ensure that actual disturbance remains within planned areas (Section 2.4.1, Annual Development Planning).
- **Construction Timing Constraints:** The BLM would not allow construction of Mine Unit 3 until interim reclamation on Mine Unit 1 has been shown to make significant progress toward meeting reclamation success criteria. Likewise, construction of Mine Unit 4 would not begin until Mine Unit 2 interim reclamation is successful, and Mine Unit 5 construction would not begin until Mine Unit 3 interim reclamation has been demonstrated to be successful (Section 2.4.2, Construction Timing Constraints).
- **Closed Loop Drilling System:** Excavated drilling mud pits would be eliminated and replaced with closed loop systems for the management of drilling fluids (Section 2.4.3, Closed Loop Drilling Systems).
- **Disturbance Offset for Additional Satellite Facility:** Disturbance associated with construction and operation of a second satellite facility would be offset through a requirement for reclamation of an equal area of existing unreclaimed or poorly reclaimed disturbance within the GHPA (Section 2.4.4, Disturbance Offset for Additional Satellite Facility).
- **Reduced Number of Evaporation Ponds:** The number of evaporation ponds would be reduced during operations, and the primary method of wastewater disposal would be injection into deep disposal wells (Section 2.4.5, Reduced Number of Evaporation Ponds).
- **Additional On-site Processing:** Additional on-site processing would produce yellowcake slurry, which would require fewer truck loads of product to the Smith Ranch-Highland facility (Section 2.4.6, Additional On-site Processing).

- **Enhanced Reclamation Goals and Timing:** Reclamation improvements would be realized through the use of rigorous reclamation goals and criteria, and by timely implementation of reclamation activities after completion of construction or operational activities (Section 2.4.7, Enhanced Reclamation Goals and Timing).
- **Burial of New Power Lines:** Impacts to wildlife would be reduced by burial of all new power lines (Section 2.4.8, Burial of New Power Lines).

Under the RPA not all of the surface area within the mine units would be disturbed by construction activity as is assumed under the Proposed Action. As shown in **Table 2-3**, the construction disturbance is estimated to be approximately 50 percent of the area of each mine unit. Approximately 30 percent of a mine unit area would undergo interim reclamation after construction and the remaining 20 percent would remain disturbed during operation. The following subsections describe in detail the changes in operations under the RPA relative to the Proposed Action as described in Section 2.3, Proposed Action.

2.4.1 Annual Development Planning

In order to reduce the surface disturbance associated with mine unit development the BLM would require submittal of an ADP prior to initiating surface disturbance activities for each calendar year. This plan would show in detail all areas of proposed surface disturbance and how all areas would be accessed by mechanized equipment for well drilling, well construction, and installation of underground utilities and overhead power lines. The plan also would show the locations of roads, header houses, valve boxes, and other features that would remain in place during mine unit operation. The ADP would include the development and use of a Topsoil Management Plan (TMP), which would address the need to maintain topsoil viability in long-term (remaining longer than 1 year) topsoil stockpiles. The overall goal of the plan would be to limit surface disturbance activities to less than the entire mine unit during construction activities and to eliminate cross-country travel during mine unit operations. Based on an analysis of the typical drill site layout (**Figure 2-6** and **Figure 2-7**) and typical mine unit pattern (**Figure A-1, Appendix A**) the BLM estimates that annual planning would result in a 50 percent reduction in surface disturbance during mine unit construction and would reduce impacts from cross-country travel by approximately 30 percent during mine unit operations.

Table 2-3 Resource Protection Alternative Disturbance Summary

Mine Component	Disturbance (acres)	
	Construction/ Decommissioning (+15 percent)[a]	**Operation (+15 percent)[a]**
Mine Unit Disturbance, Including Monitoring Well Ring		
Mine Unit 1[b]	78 (90)	31 (36)
Monitoring well ring for Mine Unit 1[c]	11 (13)	4 (5)
Mine Unit 2[b]	183 (210)	73 (84)
Monitoring well ring for Mine Unit 2[c]	10 (12)	3 (3)
Mine Unit 3[b]	45 (52)	18 (21)
Monitoring well ring for Mine Unit 3[c]	10 (12)	3 (3)
Mine Unit 4[b]	128 (147)	51 (59)
Monitoring well ring for Mine Unit 4[c]	9 (10)	3 (3)
Mine Unit 5[b]	56 (64)	22 (25)
Monitoring well ring for Mine Unit 5[c]	8 (9)	3 (3)
Subtotal for Mine Unit Disturbance	**538 (619)**	**211 (242)**

Table 2-3 Resource Protection Alternative Disturbance Summary

Mine Component	Disturbance (acres)	
	Construction/ Decommissioning (+15 percent)[a]	Operation (+15 percent)[a]
Project Infrastructure Outside of Mine Units		
Roads/Utility Corridors [d]	209	38
Surface Facilities		
Carol Shop Facility [e]	0	0
Satellite Facility [f]	0	0
Evaporation Ponds and Diversions [g]	27	27
Disposal Wells[h]	6	3
Topsoil Stockpiles	3	3
Subtotal for Disturbance Outside of Mine Units	**245**	**71**
Grand Total	**783 (864)**	**282 (313)**

[a] Mine Unit Area may expand based on results of delineation drilling, to account for this possible expansion, disturbance estimates for mine units and their associated monitoring well rings are conservatively increased by 15 percent.

[b] Disturbance of approximately 50 percent of each mine unit is anticipated during construction and decommissioning. Operational disturbance (primary and secondary roads, header houses, paths to each wellhead, valve boxes, and well heads) is conservatively estimated to be 5 percent of the Mine Unit area. An estimated 15 percent of the Mine Unit would be disturbed by planned trails (6 feet in width) to provide access to wellheads from header houses for a total disturbance of 20 percent of a Mine Unit during operation. The remaining portion of the Mine Unit disturbed during construction (30 percent of the total Mine Unit area) would undergo interim reclamation for the duration of operations.

[c] Construction disturbance for monitoring well rings is based on a disturbance width of 18 feet. Operational disturbance for monitoring well rings is based on a disturbance width of 6 feet.

[d] Road/Utility corridor construction disturbance for new, existing, and upgraded existing roads is based on a width of 60 feet for primary roads, 40 feet for secondary roads, 50 feet for underground utilities and 30 feet for buried power lines. Road/Utility corridor operational disturbance based on a width of 30 feet for primary roads, and 15 feet for secondary roads; utility corridors would undergo interim reclamation during operations. Includes disturbance for approximately 1.4 miles (8.3 acres, based on a 50-foot wide disturbance) for a process water pipeline that would not be adjacent to a proposed road.

[e] Carol Shop facility is located on 27 acres of existing disturbance and would not involve new disturbance under the Resource Protection Alternative.

[f] The disturbance for both proposed satellite facility locations was considered although only 1 would be constructed. Disturbance for each location (approximately 5 acres) includes the building plus additional area for parking and access, and would be offset by reclamation of a corresponding area. Therefore, disturbance within the GHPA due to this activity is considered to be 0 acres.

[g] Disturbance assumes construction of 2 ponds within 1 disturbance; 1 pond for operation and a second pond to accommodate repairs.

[h] Based on disturbance of 2 acres for construction and 1 acres for operation of each of 3 proposed disposal well locations. Two deep disposal test wells were drilled in 2011; further development will require re-disturbance.

Prior to any surface disturbing activity, all areas of disturbance, including 2-track access routes for mechanized equipment, would be flagged and surveyed to establish Global Positioning System (GPS) coordinates. During construction activity all mechanized equipment would be required to remain within the flagged area including during access to well sites; cross-country travel outside of flagged areas would be prohibited.

Cameco would designate reclamation coordinators responsible for ensuring that the practices identified in the ADP are followed, including any required monitoring and reporting. A reclamation coordinator would be on-site any time surface disturbance occured, particularly during more intense construction

activities such as well drilling and installation of underground utilities. The reclamation coordinator would have sufficient training in soils to provide expert input on the amount of soil to be removed when stripping topsoil and would be responsible for implementing the TMP and adjusting the plan to changing field conditions throughout the life of the Project. An objective of the TMP would be to ensure topsoil segregation to maintain topsoil viability, as proper segregation of topsoil is critical to successful reclamation. The reclamation coordinator would be responsible for documenting, by using photographs or other means approved by the BLM, that travel of mechanized equipment did not occur outside of flagged areas. Photographs also would be taken at surface water monitoring sites listed in Section 2.3.8, Existing Monitoring Plans.

The ADP would include designated access trails (assumed to be 6 feet in width) between header houses and wells within mine units to be used for accessing wells during operations. In addition, low-impact all-terrain vehicles would be used to access wells and would be restricted to these designated trails for all monitoring, maintenance, and operations-related activity. Cross-country travel outside of designated trails would be prohibited during operations.

2.4.2 Construction Timing Constraints

To ensure that interim reclamation could be successfully achieved within the GHPA, the BLM would require a demonstration that reclamation methods would meet BLM criteria for successful reclamation. Construction and reclamation of Mine Units 1 and 2 would be used to demonstrate successful reclamation. Only the infrastructure needed for Mine Units 1 and 2 would be constructed before interim reclamation success has been demonstrated.

Reclamation success would be based on a quantitative demonstration that vegetation establishment on reclaimed areas was trending toward criteria set forth in Appendix E (Reclamation Objectives and Standards) of the Lander Draft RMP (BLM 2011b). If reclamation does not appear to be approaching those criteria, adaptive management would be applied to the reclamation process, and further mine unit construction would be delayed until alternate reclamation methods had been identified and demonstrated to meet success criteria. Specifically, the BLM would not allow construction activities to start on Mine Unit 3 until successful interim reclamation of Mine Unit 1 has been achieved. Construction activities would not start on Mine Unit 4 until successful reclamation of Mine Unit 2 has been achieved, and construction activities would not start on Mine Unit 5 until successful reclamation of Mine Unit 3 has been achieved.

2.4.3 Closed Loop Drilling Systems

To reduce the amount and intensity of surface disturbance the BLM would require the use of closed loop drilling mud systems instead of excavated mud pits for the management of drilling fluids and cuttings during the drilling of all wells within the GHPA. The drill site layout would be the same as for the Proposed Action (**Figures 2-6** and **2-7**) except that the mud pit and associated topsoil and subsoil piles would be eliminated and replaced with aboveground tanks with interconnecting hoses placed on the ground surface that would contain all drilling fluids and cuttings. Use of closed loop drilling systems would eliminate the excavation of drilling mud pits and the associated topsoil and subsoil piles.

The closed loop mud rotary drilling technique is identical to standard mud rotary drilling except that the drilling fluid is circulated through a container on-site rather than circulated through a pit. Mud tanks, tubs, or portable pits are used in a multitude of different sizes and configurations depending on drilling conditions (depth and diameter of hole, geology, etc.) to separate drill cuttings from the drilling mud by screen or settling (or both). The drilling mud is then recirculated down the borehole leaving the drill cuttings behind in the mud container. Upon completion of each well drill cuttings would be disposed of at a centralized location within the mine unit or at an off-site location instead of burial within a drilling mud pit.

In addition to reducing surface disturbance associated with excavation of drill pits, the use of closed loop drilling systems could increase drilling rates thereby reducing the time required to drill a well, reduce water use during drilling, enable recycling of water and drilling mud between wells, and facilitate improved reclamation by eliminating excavation of subsoils.

2.4.4 Disturbance Offset for Additional Satellite Facility

Under the RPA the BLM would require the reclamation of existing unreclaimed or poorly reclaimed surface disturbance in the GHPA to offset surface disturbance associated with construction and operation of an additional satellite facility. As a result, there would be no net increase in surface disturbance associated with the construction of an additional satellite facility. Offsets for the satellite facility would include areas such as reclaimed roads, reduced size of header houses or the Carol Shop facility, reclamation of pre-project disturbance, or other actions selected by Cameco and approved by the BLM. If a satellite facility is constructed, it would be the same as described for the Proposed Action in Section 2.3.1.1, Satellite Facilities.

2.4.5 Reduced Number of Evaporation Ponds

Under the RPA, water would be circulated and consumed at the same rate as described for the Proposed Action (Section 2.3.1.6, Water Use) and summarized in **Table 2-2**; however, the primary means for wastewater disposal would be through deep disposal wells installed in the GHPA. For clarification, these deep wells are referred to as “disposal wells” to distinguish them from the injection wells that are part of the ISR process. Cameco currently is investigating feasibility of deep disposal wells through construction of up to 3 test wells in the GHPA. Two test wells have been completed as of January 2012, but results are not currently available. If deep disposal wells are determined to be technically feasible, disposal wells would be completed at 2 of the 3 test well locations to receive wastewater for disposal. This would enable the construction of a reduced number of evaporation ponds which would be installed as back-up to the deep disposal wells.

The BLM recognizes that disposal wells require an approved Underground Injection Control Program permit from the WDEQ-WQD. The 3 test wells would be located as described in the Proposed Action and shown in **Figure 2-4**; disposal wells would be completed at 2 of the test well locations. If Cameco is able to dispose of sufficient water without construction of any 1 of the test wells or disposal wells, the amount of disturbance avoided (approximately 2.0 acres per well) would be “credited” to Cameco and available for other disturbance, such as construction of a satellite facility, as described in Section 2.4.4, Disturbance Offset for Additional Satellite Facility.

An evaporation pond (meeting the design criteria identified under the Proposed Action) would be constructed as a secondary/backup water disposal method. Because the results of testing for the 2 deep disposal test wells started in 2011 is not complete, the BLM does not have sufficient information to determine the number of evaporation ponds or deep disposal wells necessary for the Project. For purposes of impact analysis, the BLM assumed 2 ponds would be constructed; 1 for operational purposes and a second to accommodate repairs. The evaporation pond would be equipped with fountains or other aeration equipment designed to improve evaporation and flagged or netted as necessary to reduce birds accessing the pond. The pond would be fenced as described in the Proposed Action and would contain bird ladders as needed to allow birds to escape.

2.4.6 Additional On-Site Processing

The Smith Ranch-Highland facility is authorized to receive and process yellowcake slurry source material as well as ion-exchange resin under license SUA-1511 from the U.S. NRC. Under the Proposed Action approximately 1 truck load per day of uranium bonded to ion-exchange resin would be transported to the Smith Ranch-Highland facility for further processing. In this alternative, Cameco would conduct further processing of the ion-exchange resin at the Gas Hills facility to produce yellowcake slurry, which would then be transported to the Smith Ranch-Highland facility. Because the uranium concentration in

yellowcake slurry is higher than in ion-exchange resin, the advantage of this alternative would be the transportation of fewer loads of material to the Smith Ranch-Highland facility. Due to this advantage, the BLM is analyzing this additional processing step as part of the RPA to enable comparison of the environmental impacts of slurry transportation with those of resin transportation under the Proposed Action.

Under this alternative Cameco would conduct several additional processes at the Gas Hills facility, including resin transfer and elution, uranium precipitation from solution, and uranium precipitate dewatering to produce yellowcake slurry. These additional steps are outlined in **Figure 2-10** and are discussed in more detail in the following subsections.

2.4.6.1 Resin Transfer and Elution

As discussed in Section 2.3.3.1, In-situ Recovery, uranium-laden groundwater would be treated using ion-exchange technology. The water would be pumped to the satellite facility where uranium would be adsorbed to ion-exchange resin beads that preferentially remove uranium from the solution. Once the resin in a column was sufficiently bonded with uranium, the column would be isolated from the normal process flow and the resin would be transferred into another column for uranium elution (also known as stripping), a process whereby the uranium is removed from the resin.

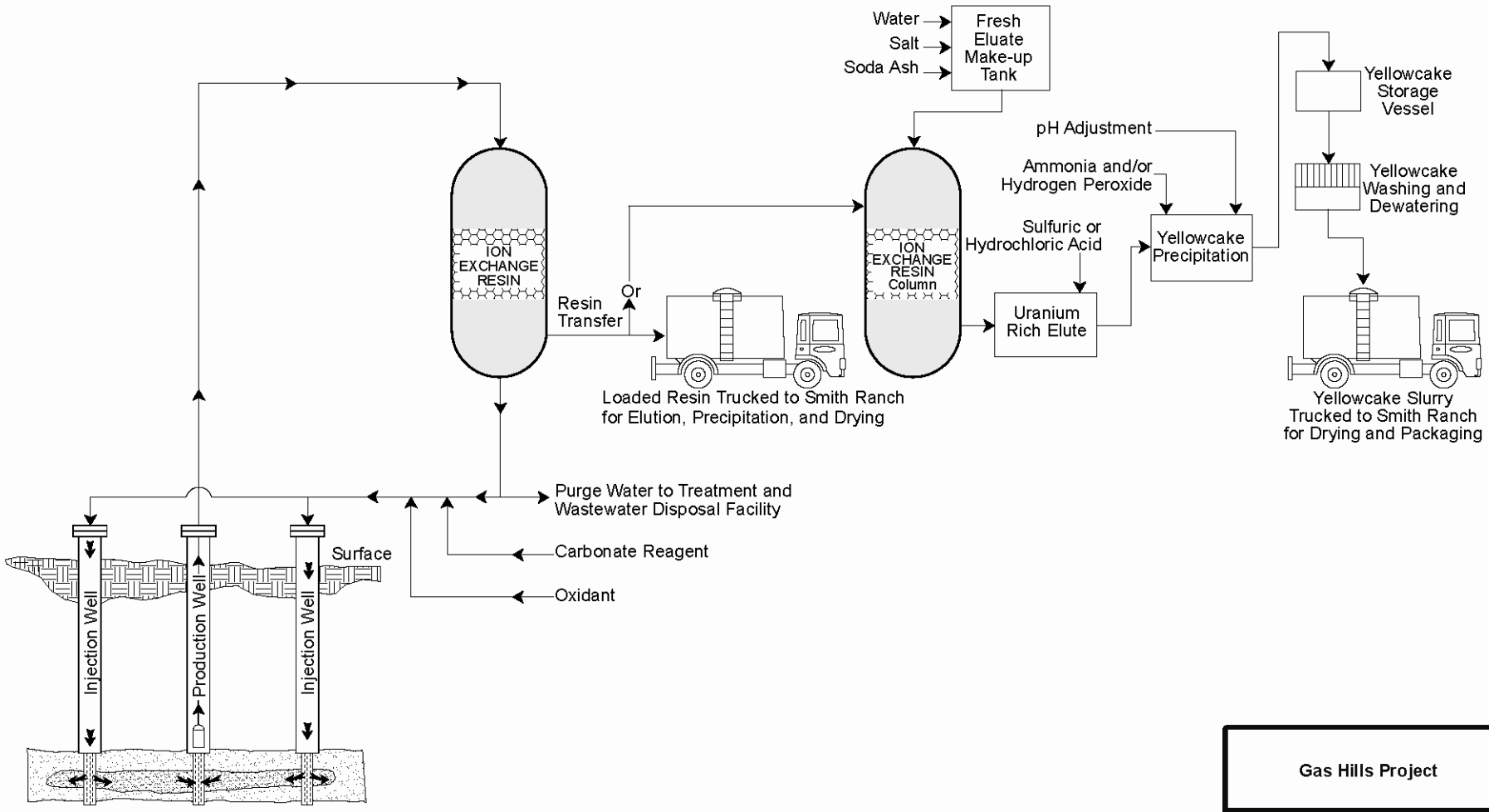
In the elution process, the resin would be contacted with a strong sodium chloride/sodium carbonate solution, which would displace (or strip) the uranium from the resin in a process very similar to regenerating a conventional home water softener. The eluted (stripped or regenerated) resin would be washed and then placed back in service for additional uranium recovery. The uranium rich fluid (rich eluate) would be pumped to the precipitation circuit for further processing.

2.4.6.2 Precipitation Circuit

The rich eluate containing the uranium would be routed to tanks for temporary storage ahead of the batch or continuous precipitation circuit. To initiate the precipitation cycle, hydrochloric or sulfuric acid would be added to the uranium-bearing solution to convert the uranyl carbonate present in the solution to uranyl chloride or uranyl sulfate, both soluble species for precipitation. Hydrogen peroxide and sodium hydroxide would then be added to the acidified eluate to effect precipitation of the uranium as uranyl peroxide or sodium diuranate. The addition of hydrogen peroxide would lower the pH of the solution, and sodium hydroxide would be added as a pH adjustment to optimize crystal growth and settling. After allowing the uranium precipitate to settle, the uranium-depleted supernate solution would be removed and stored for re-use in future elutions as lean eluate, pumped to the evaporation ponds/water treatment circuit, or disposed via deep disposal well (Section 2.3.1.2, Waste Management). Sodium chloride and sodium carbonate would be added to the lean eluate as needed for reconstitution.

2.4.6.3 Precipitate Dewatering, Filtration and Transport

The resulting slurry from the precipitation circuit would be transferred to a storage vessel, allowing the uranium to settle and consolidate by gravity. The precipitated and thickened yellowcake slurry would then be sent to a filter press for washing to remove soluble contaminates and then de-watered prior to transport to the Smith Ranch-Highland facility. The dewatered yellowcake slurry product would be placed into USDOT approved containers and transported to the Smith Ranch-Highland facility in exclusive-use, USDOT authorized transport vehicles.



Source: PRI 2011b, Figure 1.

Gas Hills Project

Figure 2-10

Diagram of Slurry Production

2.4.6.4 Additional Materials, Equipment, Energy Use, and Workforce

Additional material and chemicals that would be required to produce yellowcake slurry include additional water for eluate make-up solutions and product washing, sodium chloride and sodium carbonate for eluate make-up solutions, sulfuric and/or hydrochloric acid for pH control, and sodium hydroxide and hydrogen peroxide for precipitation. Cameco estimates the increase in water use for slurry production to be a maximum of 56 acre-feet per year from existing sources, which would correspond to an increase in consumptive water use and disposal of an additional 13 percent relative to the Proposed Action.

Additional equipment items would be located in the existing Carol Shop facility or in the second satellite facility and would include tanks for preparation and storage of eluate make-up solutions, rich eluate, precipitation, and slurry storage. A storage vessel and a filter press also would be required to complete the process. The elution/precipitation portion of the recovery plant circuit would be designed for batch or semi continuous operations. The number of batch cycles would be increased with uranium production increases. The elution circuit would operate under automated controls.

The major power requirements of an in-situ uranium facility involve the primary extraction circuit (i.e., the wellfields and associated plant circuitry). Power requirements to operate the elution and precipitation circuits are insignificant in comparison to power needed for the primary extraction circuit. Therefore, a moderate increase in power demand would be anticipated under this alternative which could be provided by the existing electrical service to the GHPA.

Cameco projects that an additional 10 workers would be required at the GHPA to carry out activities related to resin elution and yellowcake slurry generation.

2.4.6.5 Yellowcake Slurry Transport

Under this alternative yellowcake slurry would be transported to the Smith Ranch-Highland facility for further processing (drying and packaging) into yellowcake for shipping. Assuming an average production rate of 1.1 million pounds of uranium per year, the estimated number of truck loads to the Smith Ranch-Highland facility carrying yellowcake slurry would be 122 trips per year. This would be a reduction compared to the estimated 325 truck loads of resin that would be transported to Smith Ranch-Highland facility under the Proposed Action. This reduction would be partially offset by additional chemical deliveries, estimated at 1 per month per bulk chemical for hydrogen peroxide, sulfuric acid, sodium carbonate, sodium chloride, and sodium hydroxide equating to approximately 5 bulk deliveries per month. Overall, the number of transportation trips associated with yellowcake slurry production would be reduced to about ½ of those needed for the Proposed Action.

2.4.7 Enhanced Reclamation Goals and Timing

In order to promote improved reclamation with the GHPA, the BLM would require prompt reclamation of disturbed areas and the use of reclamation goals appropriate to the site's ecological potential even if the pre-disturbance vegetation included a less diverse plant community. This approach would establish a post-mining landscape closer to historic conditions present in the GHPA prior to any mining of the area rather than re-establishment of the current conditions which have been degraded by historic mining and grazing activities (BLM 1998). The following sections provide more detailed descriptions of the criteria and requirements that BLM would use to enhance reclamation within the GHPA.

2.4.7.1 Reclamation Success Criteria

In order to enhance reclamation results within the GHPA the BLM would require the evaluation of reclamation success using the reclamation criteria established in the Draft Lander RMP (BLM 2011b). The basis for these criteria is the U.S. NRCS ecological site descriptions (ESD) for each mapped ecological site found in the GHPA (USDA-U.S. NRCS 2011). An ecological site is a landform with specific physical characteristics that differ from other landforms in its ability to produce distinctive kinds and amounts of vegetation and in its response to management. For an individual ecological site the

U.S. NRCS and the BLM have developed (or are in the process of developing) ESDs to provide qualitative and quantitative data about an ecological site's biological and physical characteristics. To evaluate the functional status of an ecological site, 17 easily measurable or observable indicators have been identified that correlate with the biological and physical characteristics of an ecological site. Indicators for a site are defined in each ESD.

The following criteria are based on the ESD indicators for the ecological sites in the GHPA that would be used to evaluate interim reclamation success within a mine unit:

- 80 percent of the erosion indicator for percent ground cover (as listed on U.S. NRCS reference sheet for ESD) is met;
- At least 65 percent total plant species must be from major grasses, forbs, and/or shrubs listed in the ESD Plant Community or BLM-authorized plant species seed mix, with no noxious weeds present; and
- Must meet U.S. NRCS Reference Sheet Indicators for the ESD for erosion, compaction, and plant mortality.

Final reclamation success would be based on the following criteria:

- 90 percent of the erosion indicator for ground cover (as listed on U.S. NRCS reference sheet for ESD) is met;
- At least 80 percent total plant species must be from major grasses, forbs, and/or shrubs listed in the ESD Plant Community or BLM-authorized plant species seed mix with no noxious weeds present; and
- Must meet U.S. NRCS Reference Sheet Indicators for the ESD for erosion, compaction, and plant mortality.

Cameco would be required to submit and comply with the requirements of a noxious weed plan. The plan would identify the frequency of inspection for noxious weeds and herbicide spraying by a certified applicator. The BLM recommends, but does not require, that Fremont County Weed and Pest Department be consulted in the development of the plan. Control of noxious weeds would be met by whatever treatments necessary rather than the Proposed Action's annual spraying. Noxious weed control would be maintained around all facilities, including roads and all areas undergoing interim reclamation.

2.4.7.2 Reclamation Timing

Reclamation of construction disturbance would be started as soon as possible; as a minimum of construction was completed. Reclamation of soil disturbed to install pipelines would begin as soon as practical following construction seeding occurring during the next available seeding window.

Removal of buried infrastructure would be limited to the equipment identified by the U.S. NRC and/or the WDEQ; infrastructure that could be left in place such as buried power lines would not be removed. Reclamation of the vegetation and soils resulting from infrastructure removal would begin concurrently with removal.

Any infrastructure outside of the mine units not required for groundwater restoration or the operation of subsequent mine units would be decommissioned and reclaimed as soon as possible. Facilities would be decommissioned and reclaimed if obsolete to further plant operations.

2.4.8 Burial of New Power Lines

Approximately 21 miles of new power lines are anticipated to be constructed to supply Project components with electricity. Under this alternative, new power lines would be buried within road ROWs rather than be constructed overhead. However, burial of new power lines would have no impact on construction or operational disturbance, but would reduce potential electrocution and collision impacts to migrating and foraging migratory bird species, and would eliminate new perches for raptor and corvid species, thus reducing the potential for predation on greater sage-grouse.

2.5 Alternatives Considered but Eliminated from Further Consideration

2.5.1 Conventional Mining

Conventional mining would involve the extraction of ore by open pit or underground mining, the processing of the ore in a mill, and the disposal of mill tailings waste in a surface impoundment. The environmental impacts associated with conventional mining would be greater than the corresponding impacts of an ISR uranium recovery facility. Conventional mining methods involve excavation of soil and rock to access ore for further processing. These methods result in disturbance of the ground surface and subsurface geological materials, require the use of heavy equipment and explosives, may require dewatering during mining, and would require more overall disturbance than ISR technology. Furthermore, the target ore zones may be too deep for open pit mining methods. Given the greater disturbance footprint and potential for impacts to groundwater, surface water, vegetation, soils and wildlife, conventional mining methods will not be analyzed in detail in the EIS.

2.5.2 Seasonal Operation

This alternative would involve seasonally limiting operation of mine units to limit activity within areas with wildlife timing limitation stipulations. Control of subsurface fluids is maintained hydraulically through the injection and production process, which provides for an inward gradient within each mine unit. Because this process depends on the maintenance of constant groundwater flow gradients, the system cannot be shut down for short periods. Therefore, seasonal operation was not analyzed in detail in this EIS.

2.5.3 No Temporary Facility Closure

As stated in Section 2.3.6, Final Project Reclamation and Decommissioning, Cameco may elect under U.S. NRC regulations to place ISR operations under temporary standby for 24 months with possibility of extensions with U.S. NRC approval. The BLM was concerned that continued standby of ISR operations could result in cessation of processing activities and idling of the proposed facility without decommissioning and reclamation for an indeterminate period of time. However, under BLM's 43 CFR 3809, surface management regulations pertaining to mining-related activities (Section 3809.500), Cameco would be required to post a bond sufficient to cover the estimated costs of reclaiming the proposed operations. The bond would not be returned to Cameco until reclamation was complete, which would provide a monetary incentive for Cameco to reclaim the area, and to limit the length of a period of nonoperation. Furthermore, under Section 3809.424(a)(3), the BLM has the discretion to require removal of facilities and reclamation of the GHPA for a non-operating facility that has been inactive for 5 consecutive years. Due to these existing regulations the BLM determined it was not necessary to conduct a detailed analysis of this alternative in the EIS.

2.5.4 Additional Transportation Routes

Potential alternate transportation routes of resin or slurry from the Gas Hills site to the Smith Ranch-Highland facility were considered. Potential alternative routes considered included using Fremont County Road 5 to Jeffrey City County Road 321 south to Highway 220, roads connecting Highway 136 with Moneta or Shoshoni (Buck Camp Road or Castle Gardens Road), or County Road 201 (Poison Spider Road) to Casper. Use of these roads could reduce mileage relative to the proposed winter route through Riverton. Many of these roads are not currently designed for frequent, heavy vehicle use, and

are not maintained (plowed) during winter. Because travel during winter in the region may be hindered by snow and snow drifts, plowing snow during winter months is likely to be necessary on most routes. Because the majority of the preferred winter route to Casper (136 to Riverton, and Highways 26 and 20 to Casper) has been constructed to support projected Project traffic, the majority of these roads are currently plowed by the county during winter, and because costs associated with upgrades and plowing for alternative routes, detailed analysis of the identified potential alternate routes was not included in the EIS.

2.5.5 Alternate Waste Disposal Locations

This alternative would identify a U.S. NRC-licensed site for disposal of radiologically contaminated waste materials that was closer to the GHPA than Blanding, Utah. Current estimates of potential volumes of radiologically contaminated waste to be generated by the Project would require a maximum of 20 truck loads of material per year for transport. Transportation of radiologically contaminated waste would represent a small portion of Project-related traffic, and use of a closer disposal site would not greatly reduce traffic impacts. Therefore, this alternative was not analyzed in detail in the EIS.

2.6 Comparison of Alternatives

During development of this document, the BLM determined that no lands with sufficient size, naturalness, or outstanding opportunities for either solitude or primitive and unconfined recreation to qualify as lands with wilderness characteristics were located either solely or partially within the GHPA. The area closest to the GHPA meeting those qualifications is located southeast of Dubois, Wyoming, approximately 100 miles northwest of the GHPA (BLM 2011b). Therefore, lands with wilderness characteristics are not further described, and impacts are not further discussed for any alternative within this document.

A summary of the surface disturbance associated with each of the alternatives is presented in **Table 2-4**. A comparison of impacts associated with each of the alternatives is presented in **Table 2-5**.

Table 2-4 Summary of Surface Disturbance for the Alternatives

Facility	No Action Alternative[a]	Proposed Action Alternative	Resource Protection Alternative
Mine Units	0 (acre)	977 (acres)	490 (acres)
Water Impoundments	0 (acre)	62 (acres)	27 (acres)
Disposal Wells	0 (acre)	6 (acres)	6 (acres)
Roads-Primary (2-way traffic, maintained)[b]	11 (acres) 1.8 (miles)	90 (acres) 8.0 (miles)	90 (acres) 8.0 (miles)
Roads-Secondary (1-way traffic, maintained)[c]	0 (acre)	111 (acres)	111 (acres)
Roads-2-track (not maintained) includes monitoring well rings[d]	0 (acre)	48 (acres)	48 (acres)
Buried Process Water Line	0 (acre)	8 (acres)	8 (acres)
Carol Shop Facility[e]	27 (acres)	0 (acre)	0 (acre)
Second Satellite Facility	0 (acre)	10 (acres)	0 (acre)
Long-term Topsoil Stockpiles	3 (acres) [f]	3 (acres) [f]	3 (acres)
Total Acres Disturbance[g]	**40**	**1,315**	**783**

[a] Only activities that would occur due to selection of the No Action Alternative are represented. Disturbances would occur during reclamation of a portion of the AML road and the Carol Shop facility, including redistribution of existing topsoil stockpiles.

[b] Disturbance for new and upgraded existing primary roads would be the full 60-foot wide ROW during construction and would include disturbance for power lines and pipelines adjacent to the road. Disturbance for primary roads would be 30 feet wide during operation. Except for the AML road, existing primary roads that currently are greater than the projected operational width of the Project would be reclaimed back to 30 feet wide.

[c] Disturbance for secondary roads would be the full 40-foot wide ROW during construction and would include disturbance for power lines and pipelines adjacent to the road. Disturbance for primary roads would be 15 feet wide during operation.

[d] Includes 2-track roads associated with monitoring well rings and previously existing 2-track roads outside of mine units that would remain within the GHPA.

[e] Disturbance associated with the Carol Shop facility (26.7 acres) would be reclaimed under the No Action Alternative.

[f] Approximately 2.6 acres of topsoil piles currently existing in the GHPA would be used for reclamation of the Carol Shop Road and the Carol Shop facility. Does not include long-term topsoil stockpiles within mine unit boundaries.

[g] Discrepancies in totals are due to rounding.

Table 2-5 Comparison of Impacts

Resource/Species	No Action	Proposed Action	Resource Protection Alternative
Amount of Disturbed Lands	Least impact. Reclamation of approximately **40** acres of existing disturbance.	Most impact. Approximately **1,315** acres would be disturbed.	Less disturbance than the Proposed Action. Approximately **783** acres would be disturbed.
Air Quality	Least impact. Emissions of priority pollutants would be below regulatory thresholds, and emissions of approximately **2.5** tons of greenhouse gases would occur during the reclamation of **40** acres over 1 year.	Most impact. Emissions of priority pollutants would be below regulatory thresholds, and emissions of approximately **226,000** tons of greenhouse gases would occur during the 25-year life of the Project.	Less impact than the Proposed Action. Emissions of priority pollutants would be below regulatory thresholds, and emissions of approximately **221,500** tons of greenhouse gases would occur during the 25-year life of the Project.
Cultural Resources and Native American Concerns	Least impact. Reclamation of approximately **40** acres of previously disturbed areas would not impact historic properties, and would be unlikely to impact unanticipated discoveries.	Most impact. Three historic properties would be affected, and there would be the potential for direct impacts to unanticipated discoveries from a maximum of **1,315** acres of disturbance.	Less impact than the Proposed Action. Three historic properties would be affected and there would be less potential for direct impacts to unanticipated discoveries from a maximum of **783** acres of disturbance.
Geology			
Geologic Hazards	No impact.	Most impact. Potential hazards from disturbing **7.6** acres of existing landslide deposit, undercutting slopes greater than **25** percent on **100** acres. There would be a slight risk of increases in seismic activity from deep water disposal.	Same as the Proposed Action. While less disturbance within mine units would occur, construction in areas of existing landslide deposit and slopes greater than **25** percent would require additional precautions that are likely to not reduce disturbance in these areas. There would be a slightly higher risk of increases in seismic activity from deep water disposal, as surface disposal would be reduced.
Mineral Resources	No impact.	Most impact. The BLM would not allow development of other mineral resources during the 25-year life of the Project, but would allow this development after the Project ended. The removal of **25** to **62.5** million pounds of uranium would occur.	Same as the Proposed Action.
Land Use	No impact.	No impact. Land ownership or Special Management Areas would not be impacted.	Same as the Proposed Action.

Table 2-5 Comparison of Impacts

Resource/Species	No Action	Proposed Action	Resource Protection Alternative
Livestock Grazing	Least impact. Additional forage would be available from reclamation of approximately **40** acres of existing disturbance.	Most impact. Disturbance associated with the Project would result in impacts to **1,315** acres, and fencing would restrict livestock access to **977** acres within mine units on 3 BLM grazing allotments, resulting in the loss of **61** animal unit months over the 25-year life of the Project.	Less impact than the Proposed Action. Fencing would continue to restrict livestock access to **977** acres within mine units. Livestock grazing would be impacted by evaporation ponds on **35** acres of lands less than under the Proposed Action, resulting in the loss of 1 fewer animal unit months over the 25-year life of the Project.
Noise	Least impact. Noise associated with reclamation activities would be minimal and would be short-term.	Most impact. Noise impacts would be greatest during the construction phase of the project. Impacts during operations would consist mostly of vehicle traffic noise. The absence of noise-sensitive receptors in the GHPA would result in negligible impacts.	Less impact than the Proposed Action. Noise from traffic during Project operation would be reduced due to approximately 193 fewer large truck trips per year.
Paleontological Resources			
Fossil Resources	Least impact. The potential for exposing fossil-bearing formations during reclamation of approximately **40** acres of existing disturbance is low.	Most impact. Surface disturbance with high potential to expose and impact fossil resources would occur on **1,114** acres within the GHPA.	Less impact than the Proposed Action. Surface disturbance with high potential to expose and impact fossil resources would occur on **665** acres within the GHPA. Additionally, the likelihood of exposing fossil-bearing formations would be reduced by eliminating excavation associated with drilling mud puts.
Public Health and Safety			
Radiological Exposure	No impact. Long-term monitoring of background radiation from previous mining activities would continue.	Most impact. The highest estimated dose of radiation to surrounding communities would be **7** millirem/year (7 percent of limit listed in 10 CFR Part 20). Radiation also would be monitored according to U.S. NRC rules; therefore, impacts would be low.	Same as the Proposed Action.
Hazardous Materials and Waste	Least impact. Any radiologically contaminated waste generated by reclamation of approximately **40** acres, including the Carol Shop facility, would be disposed of according to	Most Impact. On-site storage of hazardous materials would include an estimated maximum of **6,000** gallons of diesel fuel and gasoline, **100** short tons of sulfuric acid, and **10** short tons	Less than the Proposed Action. On-site storage of hazardous materials would be the same as for the Proposed Action. Accidents during the transportation of hazardous

Table 2-5 Comparison of Impacts

Resource/Species	No Action	Proposed Action	Resource Protection Alternative
	existing permits.	of sodium hydroxide. Accidents during the transportation of hazardous materials could occur an estimated 0.04 times during the Project. Accidents during the transportation of uranium-laden resin could occur an estimated 0.58 times during the Project.	materials could occur an estimated 0.05 times during the Project. Accidents during the transportation of uranium-laden yelllowcake slurry could occur an estimated 0.21 times during the Project. The accident rate for the transportation of uranium-laden yellowcake slurry would decline as the result of fewer trips between the Gas Hills Facility and the Smith Ranch-Highland facility.
Recreation	Least impact. Recreational activities could occur on approximately 40 acres of reclaimed land.	Most impact. Impacts most likely to occur would be a reduction in wildlife viewing and hunting due to animal displacement from Project-related noise. Historical uranium mining and no developed recreational facilities in the GHPA have limited current recreation, and would result in a low impact to recreation.	Less impact than the Proposed Action. The same number of roads would be constructed as for the Proposed Action, but **193** fewer heavy truck trips would occur, which would result in less noise and less reduction in wildlife viewing and hunting due to animal displacement.
Socioeconomic Conditions			
Population, Employment, and Income	Least impact. No new jobs or households would be created.	Less impact than the RPA. **148** new jobs would be created, and **58** new households would be created.	Most impact. **166** new jobs would be created and **68** new households would be created.
Environmental Justice	No disproportionate impact to poorer communities.	No disproportionate impact to poorer communities.	No disproportionate impact to poorer communities.
Soils	Least impact. The reclamation of existing disturbance, including redistribution of long-term topsoil stockpiles, would improve soil productivity on approximately 40 acres.	Most impact. Approximately **1,315** acres of topsoil and biological crusts would be disturbed. Impacts to sensitive soils within mine units (**508** acres of water erodible soils, **79** acres of compaction prone soils, **297** acres of soils with low revegetation potential, **9** acres of shallow soils, and **197** acres of stony-rocky soils) would occur. The potential for mixing topsoil and subsoil would occur from any excavation. Mixing of topsoil and subsoil, as well as compaction, also would be likely from cross-country vehicular	Less impact than the Proposed Action. Approximately **783** acres of topsoil and biological crusts would be disturbed. The reduction of disturbance within mine units would maintain topsoil viability, and reduce direct impacts to sensitive soils than the Proposed Action. Additionally, the potential to mix topsoil and subsoil would be reduced by eliminating excavation associated with drilling mud pits, and by eliminating cross-country vehicular travel. Elimination of cross-country vehicular travel also

Table 2-5 Comparison of Impacts

Resource/Species	No Action	Proposed Action	Resource Protection Alternative
		travel.	would reduce soil compaction.
Transportation	Least impact. No new roads would be constructed. Additional traffic would be as a result of the reclamation of **1.8** miles of roads within the GHPA. Travel volume would not change from current levels.	Most impact. Approximately **23** miles of new primary or secondary roads would be constructed. Traffic on roads to the GHPA would increase by a maximum average of **27** heavy and **56.7** light truck trips per day from construction and operation traffic.	Less impact than the Proposed Action. There would be no difference in miles of roads constructed, but heavy truck trips would decline to **26.5** trips per day as a result of fewer loads of uranium-laden material transported to the Smith Ranch-Highland facility and more loads of chemicals transported to the GHPA.
Vegetation	Least impact. The reclamation of existing disturbance would improve the vegetation cover and community diversity on approximately **40** acres.	Most impact. Disturbance would occur on **743** acres of shrub-dominated vegetation, which would take 3 to 5 years to reestablish. Disturbance also would occur on **15** acres n wetlands.	Less impact than the Proposed Project. Disturbance would occur on **458** acres of shrub-dominated vegetation, which would take 3 to 5 years to reestablish. Additionally, 8 acres of wetlands would be disturbed.
Noxious Weeds and Invasive Species	Least impact. The reclamation of existing disturbance would include control o noxious weeds and invasive species on approximately **40** acres.	Most impact. The disturbance of **1,315** acres would have the potential to allow establishment of noxious weeds and invasive species.	Less impact than the Proposed Project. The disturbance of **783** acres would have the potential to allow establishment of noxious weeds and invasive species.
Special Status Plant Species	No impact.	Most impact. Disturbance from the Project has the potential to directly impact individuals of the following species: Cedar rim thistle; and Rocky Mountain twinpod. The Project also has the potential to indirectly impact, through the spread of noxious weeds and invasive plant species, fugitive dust, or changes in surface water flow, the following species: Persistent sepal yellowcress; Cedar rim thistle; Beaver rim phlox; Rocky Mountain twinpod; and	Less impact than the Proposed Project. The same species as listed for the Proposed Project could be directly or indirectly impacted; however, reduced disturbance within the mine units would reduce the potential for impacts to these species.

Table 2-5 Comparison of Impacts

Resource/Species	No Action	Proposed Action	Resource Protection Alternative
		Limber pine.	
Visual Resources	Least impact. The reclamation of approximately **40** acres would temporarily cause minimal impacts to visual resources.	Most impact. Visual resources would be impacted during Project construction and would be moderately impacted during Project operation.	Same as the Proposed Action.
Water Resources			
Surface Water	Least impact. Reclamation of approximately **40** acres of previous disturbance within the GHPA would restore surface contours to approximate original drainage patterns.	Most impact. Disturbance would occur on **1,315** acres, including **15** acres of wetlands. Roads and other construction within waterways could alter existing channel geometry and cause additional headcutting, bank failure, and sedimentation. The potential of a spill of uranium-laden resin into a river during transportation would be 0.008 spills in 25 years.	Less impact than the Proposed Project. Disturbance would occur on **783** acres, including **8** acres in wetlands. The potential for impacts to waterways would be reduced. Annual development planning would encourage avoidance of, and would reduce the potential for road development in, waterways. The potential of a spill of yellowcake slurry into a river during transportation would be 0.002 spills in 25 years.
Groundwater	Least impact. No groundwater impacts would occur beyond those from past mining activity.	Most impact. Groundwater quality and quantity would be impacted by the ISR process during mine operation. Impacts would be restricted to the area within mine units and corresponding monitoring well rings (2,122 acres). Groundwater quantity would be restored to pre-mining levels prior to mine closure. Groundwater quality would be restored to pre-mining conditions, or to class of use based on WDEQ guidelines.	Same as the Proposed Action.
Water Use	No impact.	Most impact. Consumptive use of groundwater for ISR mining would occur; however, this use would not impact holders of existing water rights within the GHPA.	Same as the Proposed Action.
Wild Horses	No impact within the GHPA.	No impact within the GHPA.	No impact within the GHPA.

Table 2-5 Comparison of Impacts

Resource/Species	No Action	Proposed Action	Resource Protection Alternative
Wildlife and Fisheries (incremental acres of habitat disturbed)			
Big Game, Small Game, Raptors, Migratory Birds, Reptiles, and Amphibians	Least impact. Reclamation of approximately **40** acres of previous disturbance within the GHPA would have minimal impact.	Most impact. Approximately **1,206** acres of habitat would be disturbed.	Less impact than the Proposed Project. Approximately **733** acres of habitat would be disturbed.
Special Status Wildlife Species (incremental acres of habitat disturbed)			
White-tailed Prairie Dog	No impact.	Most impact. Approximately **5.6** acres of habitat disturbance.	Less impact than the Project. Approximately **3.0** acres of habitat disturbance.
Pygmy Rabbit	No impact.	Most impact. Approximately **93** acres of habitat disturbance.	Less impact than the Project. Approximately **65** acres of habitat disturbance.
Sensitive Bat Species	No impact.	Most impact. Approximately **1,206** acres of habitat disturbance.	Less impact than the Project. Approximately **733** acres of habitat disturbance.
Ferruginous Hawk	No impact.	Most impact. Approximately **1,206** acres of habitat disturbance.	Less impact than the Project. Approximately **733** acres of habitat disturbance.
Burrowing Owl	No impact.	Most impact. Approximately **834** acres of habitat disturbance	Less impact than the Project. Approximately **510** acres of habitat disturbance.
Greater Sage-grouse	No impact.	Most impact. Approximately **422** acres of habitat disturbance.	Less impact than the Project. Approximately **260** acres of habitat disturbance.
Brewer's Sparrow, Loggerhead Shrike, Sage Sparrow, Sage Thrasher	No impact.	Most impact. Approximately **1,206** acres of habitat disturbance.	Less impact than the Project. Approximately **733** acres of habitat disturbance.
Mountain Plover	No impact.	Most impact. Approximately **1.3** acres of habitat disturbance.	Less impact than the Project. Approximately **0.8** acre of habitat disturbance.
Northern Leopard Frog, Great Basin Spadefoot	No impact.	Most impact. Approximately **15** acres of habitat disturbance.	Less impact than the Project. Approximately **8** acres less habitat disturbance compared to the Proposed Action.
Sensitive Species	No impact.	Most impact. The Project has a low potential to	Same as Proposed Action.

Table 2-5 Comparison of Impacts

Resource/Species	No Action	Proposed Action	Resource Protection Alternative
		impact the following species: White tailed prairie dog; Pygmy rabbit; BLM sensitive bat species; Ferruginous hawk; Burrowing owl; Greater sage-grouse; Brewer's sparrow; Loggerhead shrike; Sage sparrow; Sage thrasher; Mountain plover; Northern leopard frog; and Great Basin spadefoot.	

3.0 Affected Environment

This chapter describes the current condition of the environment for the GHPA (see **Figure 1-1**) and vicinity that potentially could be impacted by the alternatives presented in Chapter 2.0. Under NEPA, the human environment is the natural and physical environment and the relationship of people to that environment. The affected environment for individual resources was delineated based on the area of potential direct and indirect environmental impacts for the Project and the associated cumulative effects area. For some resources, the resulting study area includes the GHPA, while other resources (e.g., watersheds, air quality, or transportation network) are addressed in a larger regional context.

The environmental baseline information summarized in this chapter was obtained from Cameco's WDEQ-LQD mine permit update (PRI 2009), review of published sources, unpublished data, communications with government agencies, and review of field studies of the area. The level of information provided in this chapter is intended to be commensurate with the potential impacts to the resource described.

3.1 Air Quality

The following sections discuss the meteorology, climatology, and air quality at the GHPA. A discussion of climate change and greenhouse gases (GHGs) also is included in this section of the Draft EIS.

3.1.1 Climate and Meteorology

The GHPA is located in the Gas Hills District of Fremont and Natrona counties, at an elevation of approximately 7,250 feet above mean sea level (amsl). The region experiences diverse weather patterns that fluctuate throughout the year, due in large part to its proximity to the Rocky Mountains and its relatively high elevation.

The climate of the area surrounding the GHPA is semiarid and cool. Prevailing westerly winds are most pronounced during the winter, while in the summer, circulation patterns bring moist air and precipitation from the Gulf of Mexico. Hailstorms are the most destructive type of local storm in the state, and crop and property damage from hail is significant (National Oceanic and Atmospheric Administration 1985). Tornadoes also occur in the state but are less frequent and destructive in the region than in the Midwest. Summers are mild with warm to hot days and cool nights. Winters are harsh with cold temperatures, high winds, and infrequent blizzards. Warm days and cold nights occur during both spring and fall; wet heavy snowfalls can be expected in both of these seasons. The growing season is between 90 and 120 days long, from late May to early September. July is typically the warmest month and January the coldest.

The climatic and meteorological data for the GHPA is from the Gas Hills 4E National Weather Service Station (NWS), located approximately 1 mile north of the GHPA (**Table 3.1-1**), and the Casper NWS station located approximately 65 miles east of the GHPA, at the Natrona County International Airport near Casper, Wyoming (**Table 3.1-2**). Use of data from the NWS station in Lander, about 55 miles west of the GHPA was considered; however, the data at this station was not determined to be representative of the GHPA due to its proximity to the Wind River Mountains. The Gas Hills 4E NWS station records temperature and precipitation data only. The Lucky Mc Mine, located adjacent to the western part of the GHPA, recorded wind data intermittently from September 1978 through January 1983 (U.S. NRC 2004).

At the Gas Hills 4E NWS station, July is the warmest month and January the coldest. Based on nearly 45 years of record (September 1962 to April 2007), the mean maximum and mean minimum

Table 3.1-1 Gas Hills 4E, Wyoming (483801) Monthly Climate Summary: 9/10/1962 to 4/30/2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (°F)	28.4	32.4	40.2	51.0	62.5	73.3	82.2	80.2	69.4	57.0	39.1	30.4	53.8
Average Min. Temperature (°F)	11.0	13.8	19.5	28.4	37.4	46.7	53.6	52.5	42.8	33.1	20.8	13.2	31.1
Average Total Precipitation (inches)	0.38	0.38	0.72	1.20	1.59	1.33	0.86	0.64	0.74	0.68	0.42	0.35	9.28
Average Total Snow Fall (inches)	7.3	7.7	9.9	10.4	2.8	0.5	0.0	0.0	1.2	5.5	6.5	7.0	58.7
Average Snow Depth (inches)	2	2	2	1	0	0	0	0	0	0	1	2	1

Source: Western Region Climate Center (WRCC) 2011.

Table 3.1-2 Period of Record Monthly Climate Summary: 8/1/1948 to 12/31/2010 for Casper Weater Service Office Airport, Wyoming

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (°F)	33.7	37.8	45.8	56.1	66.7	78.6	87.7	85.8	74.4	60.5	44.6	35.2	58.9
Average Min. Temperature (°F)	13.0	16.4	21.6	29.3	38.3	46.9	54.1	52.5	42.4	32.5	22.2	14.9	32.0
Average Total Precipitation (inches)	0.51	0.55	0.90	1.40	2.08	1.41	1.22	0.72	0.95	1.01	0.69	0.55	11.99
Average Total Snow Fall (inches)	10.0	10.0	12.9	12.1	3.9	0.2	0.0	0.0	1.3	6.3	9.8	10.4	76.9
Average Snow Depth (inches)	1	1	1	0	0	0	0	0	0	0	1	1	0

temperatures are 82.2 degrees Fahrenheit (°F) and 53.6°F, respectively, in July, and 28.4°F and 11.0°F, respectively, in January (**Table 3.1-1**). The highest and lowest temperatures recorded during the period of record are 96°F and -34°F. The mean annual precipitation at the Gas Hills 4E NWS station is approximately 9.28 inches. About half of the annual precipitation occurs between April and June, while less than a third occurs from October through March. Snow commonly falls as early as October and often as late as May. From 1948 to 2010, annual snowfall at the Casper NWS station averaged

76.9 inches. Monthly snowfall amounts from November through February are relatively uniform, and snowfall generally increases slightly during March and April (WRCC 2011).

Wind conditions at the GHPA are represented by the data collected at the Casper NWS station. A comparison of wind data at the Casper NWS station and those recorded at the Lucky Mc Mine indicated that the Casper wind data are representative of the GHPA. Based on the wind data collected by the Casper NWS station for the period of 1996-2008, average wind speed was about 11.7 mph (WRCC 2011). The fastest observed 2-minute wind was 64 mph in January, with the second fastest of 54 mph in June (**Table 3.1-3**). The highest peak gust wind speed at the Casper NWS station for this period was 81 mph in July and a peak gust wind greater than 50 mph was observed every month of the year.

Table 3.1-3 Casper-Natrona County International AP Climatological Summary: July 1996 to December 2008

Wind (mph)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Avg.
Daily Avg Wind Speed	14.8	13.6	12.5	11.4	10.5	10.2	8.9	9.3	9.8	10.9	13.4	15.1	11.7
Daily Avg Max 2-Min	27.6	26.0	25.7	25.3	24.7	26.1	24.8	23.7	22.9	23.7	26.1	28.3	25.4
Daily Avg Peak Gust	32.6	31.0	30.6	31.1	30.7	32.5	31.2	29.6	28.4	28.7	31.2	33.9	31.0
Maximum Daily Avg	31.5	31.5	27.7	26.0	26.8	27.3	20.4	21.7	21.2	25.1	29.3	31.6	31.6
Maximum 2-Minute Avg	64	51	49	49	45	54	52	46	44	51	51	53	64
Maximum Peak Gust	78	66	60	63	54	66	81	58	59	61	63	68	81
Avg Number of Days													
Peak Gust >=30	18.6	15.9	16.5	15.0	16.5	16.8	15.8	14.5	11.9	13.9	16.9	20.4	192.6
Peak Gust >=40	7.9	4.7	5.7	5.0	4.9	5.7	4.8	4.0	3.5	3.3	6.2	9.2	64.9
Peak Gust >=50	2.2	0.8	1.4	1.5	0.7	1.4	1.5	0.5	0.2	0.9	1.5	2.3	14.8

Source: WRCC 2011.

Annual-average relative humidity in the area ranges from 64 to 71 percent for the nighttime hours and from 43 to 46 percent for daytime hours. The NWS station recording evaporation data nearest to the GHPA is located approximately 60 miles southeast of the GHPA, at the Pathfinder Reservoir. Annual mean lake evaporation is estimated at approximately 42 inches. The NWS estimates the mean annual potential evapotranspiration rate at Pathfinder Reservoir to be about 22 inches (U.S. NRC 2004).

3.1.2 Air Quality

The GHPA is located in the Casper Intrastate Air Quality Control Region, which covers the central part of the State of Wyoming. The State of Wyoming Ambient Air Quality Standards (WAAQS) for 6 criteria pollutants, sulfur oxides (as sulfur dioxide [SO_2]), particulate matter (PM), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and lead (Pb), are nearly identical to the National Ambient Air Quality

Standards (NAAQS) with a few exceptions (Wyoming Rules and Regulations of Department of Environmental Quality). One exception is that the WAAQS for SO_2 are more stringent than the NAAQS. Another exception is that the annual PM with an aerodynamic diameter of 10 microns or less (PM_{10}) standard is still in effect in the State of Wyoming even though there is no annual PM_{10} NAAQS. Finally, Wyoming has not yet adopted the 1-hour SO_2 and 1-hour NO_2 NAAQS (WDEQ-AQD 2010).

The NAAQS and WAAQS are listed in **Table 3.1-4**.

Table 3.1-4 State and National Ambient Air Quality Standards

Pollutant	Averaging Period	Wyoming Standards ($\mu g/m^3$)[a]	National Standards	
			Primary	Secondary
PM_{10}	24-hour	150[b] $\mu g/m^3$	150[b] $\mu g/m^3$	Same as primary
	Annual	50 $\mu g/m^3$	None	None
$PM_{2.5}$ [a]	24-hour	35 $\mu g/m^3$	35 $\mu g/m^3$	Same as primary
	Annual	15 $\mu g/m^3$	15 $\mu g/m^3$	Same as primary
SO_2	1-hour	----	196 $\mu g/m^3$	None
	3-hour	1,300[b] $\mu g/m^3$ (0.5 parts per million [ppm])	(0.075 ppm) None	1,300[b] $\mu g/m^3$ (0.5 ppm)
	24-hour	260[b] $\mu g/m^3$ (0.1 ppm)	365[b] $\mu g/m^3$ (0.14 ppm)	None
	Annual	60 $\mu g/m^3$ (0.023 ppm)	80 $\mu g/m^3$ (0.03 ppm)	None
NO_2	1-hour	----	188 $\mu g/m^3$ (0.100 ppm)	Same as primary
	Annual	100 $\mu g/m^3$ (0.053 ppm)	100 $\mu g/m^3$ (0.053 ppm)	Same as primary
CO	1-hour	40,000[b] $\mu g/m^3$ (35 ppm)	40,000[b] $\mu g/m^3$ (35 ppm)	None
	8-hour	10,000[b,c] $\mu g/m^3$ (9 ppm)	10,000[b] $\mu g/m^3$ (9 ppm)	None
O_3	8-hour (2008 standard)[c]	----	147 $\mu g/m^3$ (0.075 ppm)	Same as primary
	8 hours (1997 standard)[d]	157 $\mu g/m^3$ (0.08 ppm)	157 $\mu g/m^3$ (0.08 ppm)	Same as primary
Pb	Rolling 3-month Average	0.15 $\mu g/m^3$	0.15 $\mu g/m^3$	Same as primary

[a] $\mu g/m^3$ = micrograms per cubic meter.
$PM_{2.5}$ particulate matter with an aerodynamic diameter of 2.5 microns or less.

[b] Must not be exceeded more than once per year.

[c] To attain this standard, the 3-year average of the 4th highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).

[d] (i) To attain this standard, the 3-year average of the 4th highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(ii) The 1997 standard, and the implementation rules for that standard, would remain in place for implementation purposes as USEPA undertakes rulemaking to address the transition from the 1997 O_3 standard to the 2008 O_3 standard.

Sources: USEPA 2011d; WDEQ-AQD 2010.

Ambient air quality in the State of Wyoming is good, and the state is currently designated as in attainment for all criteria pollutants except PM_{10} for the city of Sheridan (USEPA 2011d). In 2009 the Wyoming governor recommended to USEPA that Sublette County and Portions of Sweetwater and Lincoln counties in Southwestern Wyoming be declared non-attainment for ozone.

PSD regulations (40 CFR 52.21) limit the maximum allowable incremental increases in ambient concentrations of SO_2, NO_2, and PM_{10} above established baseline levels. The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to major new sources and modifications to existing sources. The State of Wyoming is in a Class II PSD area and contains 7 Class I PSD areas consisting of national parks and national wilderness areas. PSD Class I areas nearest to the GHPA include Bridger National Wilderness Area about 80 miles to the west of the GHPA and Wind Cave National Park in South Dakota approximately 220 miles to the east-northeast. Monitored values of criteria pollutants in Fremont and Natrona counties are listed in **Table 3.1-5**.

Table 3.1-5 Monitor Data in the Vicinity of the GHPA 2009

County	CO 8-hr (ppm)	Pb RQmax (µg/m^3)	NO_2 AM (ppm)	O_3 8-hr (ppm)	PM_{10} 24-hr (µg/m^3)	$PM_{2.5}$ Wtd AM (µg/m^3)	$PM_{2.5}$ 24-hr (µg/m^3)	SO_2 AM (ppm)	SO_2 24-hr (ppm)
Fremont	ND	ND	0.001	0.08	47	8.3	35	IN	IN
Natrona	ND	ND	ND	ND	51	IN	IN	ND	ND

CO 8-hour – Highest second maximum non-overlapping 8-hour concentration (applicable NAAQS is 9 ppm).

Pb RQmax – Maximum running 3 month average (applicable NAAQS is 0.15 µg/m^3).

NO_2 AM – Highest arithmetic mean concentration (applicable NAAQS is 0.053 ppm).

O_3 8-hour – Highest 4th daily maximum 8-hour concentration (applicable NAAQS is 0.075 ppm).

PM_{10} 24-hour – Highest 2nd maximum 24-hour concentration (applicable NAAQS is 150 µg/m^3).

$PM_{2.5}$ Wtd AM – Highest weighted annual mean concentration (applicable NAAQS is 15 µg/m^3).

$PM_{2.5}$ 24-hour – Highest 98th percentile 24-hour concentration (applicable NAAQS is 35 µg/m^3).

SO_2 AM – Highest annual mean concentration (applicable NAAQS is 0.03 ppm).

SO_2 24-hour – Highest second maximum 24-hour concentration (applicable NAAQS is 0.14 ppm).

ND – Indicates data not available.

IN – Indicates insufficient data to calculate summary statistic.

µg/m^3 – Units are micrograms per cubic meter.

ppm – Units are parts per million.

Source: USEPA 2009.

3.1.2.1 Regulatory Framework and Associated Impacts

Ambient air quality and the emission of air pollutants are regulated under both federal and State of Wyoming laws and regulations as discussed below.

Federal Clean Air Act

The CAA, and the subsequent Federal Clean Air Act Amendments of 1990 (CAAA), require the USEPA to identify NAAQS to protect public health and welfare. The CAA and the CAAA established NAAQS for 7 pollutants, known as “criteria” pollutants. The ambient standards set for these pollutants satisfy “criteria” specified in the CAA. A list of the criteria pollutants regulated under the CAA and their currently applicable NAAQS set by the USEPA are listed in **Table 3.1-4**.

In addition to the designations relative to conforming with the NAAQS, the CAA requires the USEPA to place selected areas within the U.S. into 1 of 3 classes, which are designed to limit the deterioration of air quality when it is “better than” the NAAQS. Class I is the most restrictive air quality category. It was created by Congress to prevent further deterioration of air quality in national parks and wilderness areas of a given size, which were in existence prior to 1977, or those additional areas that have since been designated Class I under federal regulations (40 CFR 52.21). All remaining selected areas outside of the designated Class I boundaries were designated Class II areas, which allow a relatively greater deterioration of air quality, although still below NAAQS. No Class III areas have been designated.

Federal PSD regulations limit the maximum allowable increase in ambient particulate matter in a Class I area resulting from a major or minor kind of stationary source to 4 $\mu g/m^3$ (annual geometric mean) and 8 $\mu g/m^3$ (24-hour average). Increases in other criteria pollutants are similarly limited. Specific types of facilities (listed facilities) that emit, or have the potential to emit, 100 tons per year (tpy) or more of total PM, PM_{10}, or other criteria air pollutants, or any facility that emits, or has the potential to emit, 250 tpy or more of total PM, PM_{10}, or other criteria air pollutants, are considered major stationary sources. Major stationary sources (e.g., coal-fired power plant, refinery, compressor station, or cement plant) are required to notify federal land managers of Class I areas, which may be affected by the emissions from the source within 100 kilometers (km) (62 miles) of the major stationary source.

The PSD increments are triggered for a planning area when a PSD application for a major source or modification affecting that planning area has been deemed complete by the regulatory authority (40 CFR 52.21[b][14]).

New Source Performance Standards, also required under the CAA, are set by the USEPA for specific types of new or modified stationary sources (i.e., sources that are fixed in place, as opposed to mobile sources). New Source Performance Standards set fixed emission limits for classes of sources to prevent deterioration of air quality from the construction of new sources and to reduce control costs by building pollution controls into the initial design of sources.

The Federal Operating Permit, or “Title V”, is a facility-wide permitting program introduced by the CAA that requires facilities with the potential to emit more than 100 tpy of any regulated pollutant (excluding PM), 10 tpy of any single hazardous air pollutant (HAP), or 25 tpy or more of any combination of HAPs, sources” of air pollutants submit a Federal Operating Permit application.

The CAA directs the USEPA to delegate primary responsibility for air pollution control to state governments, which comply with certain minimum requirements. The State Implementation Plan (SIP) was originally the mechanism by which a state set emission limits and allocated pollution control responsibility to meet the NAAQS. The function of a SIP broadened after passage of the CAAA and now includes the implementation of specific technology-based emission standards, permitting of sources, collection of fees, coordination of air quality planning, and prevention of significant deterioration of air quality within regional planning areas and statewide. Section 176 of the CAA, as amended, requires that federal agencies must not engage in, approve, or support in any way any action that does not conform to a SIP for the purpose of attaining NAAQS (USEPA 2008a).

3.1.2.2 Climate Change and GHG Emissions

GHGs, including carbon dioxide (CO_2); methane; nitrous oxide (N_2O); water vapor; and several trace gas emissions cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the Earth back into space. Science recognizes that such GHGs are essential to the formation and continuation of life on the planet, since global warming has produced the conditions conducive to allow the existence of all living things on the Earth. Science also has identified some potentially unwanted impacts of human activities on global climate. Vulnerabilities to climate change depend considerably on specific geographic and social contexts.

Although climate changing pollutant levels have varied for millennia (along with corresponding variations in climatic conditions), recent industrialization and burning of fossil carbon sources caused CO_2 concentrations to increase from a pre-industrial value of about 280 ppm to 379 ppm in 2005. This increase is likely to contribute to climatic changes that may be disruptive to present plant, animal, and human communities. For example, increasing CO_2 concentrations may lead to preferential fertilization and growth of specific plant species.

The Intergovernmental Panel on Climate Change (IPCC) has completed a comprehensive report assessing the current state of knowledge on climate change, its potential impacts, and options for adaptation and mitigation. According to this report, global climate change may ultimately contribute to a rise in sea level, destruction of estuaries and coastal wetlands, and changes in regional temperature and rainfall patterns, with major implications to agricultural and coastal communities. The IPCC has suggested that the average global surface temperature could rise 1 to 4.5 °F in the next 50 years, with significant regional variation. There are uncertainties regarding how climate change may affect different regions. Computer models indicate that such increases in temperature will not be equally distributed globally, but are likely to be accentuated at higher latitudes. Also, warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures is more likely than increases in daily maximum temperatures (IPCC 2007).

The analysis of the regional climate impacts prepared by the U.S. Global Change Research Program (2009) indicates that average temperatures have increased throughout the region with relatively cold days becoming less frequent and relatively hot days more frequent. The observed increase is largely the result of the warmer nights and effectively higher average daily minimum temperatures at many of the sites in the region. The analysis projects continued increases in temperature over this century. The U.S. Global Change Research Program report projects an increase in precipitation in the central and northern portions of Wyoming, although with substantial variability in inter-annual conditions. For central Wyoming the projections range from approximately 10 to 20 percent increase in annual precipitation.

3.2 Cultural Resources and Native American Concerns

3.2.1 Cultural Resources

Cultural resources are definite locations of human activity, occupation, or use identifiable through field inventory (survey), historical documentation, or oral evidence. The term includes archaeological, historic, or architectural sites; structures or places with important public and scientific uses; and may include definite locations (sites or places) of traditional, cultural, or religious importance to specified social and/or cultural groups. Cultural resources are concrete, material places and things that are located, classified, ranked, and managed through the system of identifying, protecting, and utilizing for public benefit (BLM 8100 Manual).

3.2.1.1 Regulatory Framework

Federal historic preservation legislation provides a legal environment for documentation, evaluation, and protection of cultural resources that may be affected by federal undertakings or by private undertakings operating under federal license, with federal funding, or on federally managed lands. These include, but are not limited to the NHPA, ARPA, and Archaeological and Historic Preservation Act of 1974. Executive Order 11593 (Protection and Enhancement of the Cultural Environment) also provides necessary guidance on protection and enhancement of cultural resources.

The NHPA requires federal agencies to take into account the effects of their actions on properties listed on or eligible for listing on the National Register of Historic Places (NRHP). Section 106 of the NHPA establishes a 4-step review process by which cultural resources are given consideration during the evaluation of proposed undertakings. The regulations require that federal agencies initiate Section 106 consultation early in project planning, when a broad range of alternatives can be considered (36 CFR 800.1[c]). Cultural resources that are listed or eligible for inclusion in the NRHP are referred to as “historic properties.”

3.2.1.2 Criteria of Eligibility

The NRHP, maintained by the NPS on behalf of the Secretary of the Interior, is the nation’s inventory of historic properties. The NPS has established 3 main standards that a property must meet to qualify for listing on the NRHP: age, integrity, and significance. To meet the age criteria, a property generally must be at least 50 years old. To meet the integrity criteria, a property must “possess integrity of location, design, setting, materials, workmanship, feeling, and association” (36 CFR 60.4). Finally, a property must be significant according to 1 or more of the following criteria:

- Criterion A – Be associated with events that have made a significant contribution to the broad patterns of our history;
- Criterion B – Be associated with the lives of persons significant in our history;
- Criterion C – Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or
- Criterion D – Have yielded, or may be likely to yield, information important in prehistory or history.

3.2.1.3 Cultural-Historical Overview

The following brief general summaries were extrapolated from Frison (2001), Kalasz et al. (2007), Metcalf (1987); Natrona County (2011), U.S. NRC (2009a), and Roberts (2011).

Prehistoric Narrative

The GHPA is part of the Northwestern Plains which cover a large share of eastern Montana and Wyoming east of the Rocky Mountains along with the northwest corner of Nebraska, extreme western North and South Dakota, and an extension into southwest Alberta. There are 6 periods of human occupation in the Northwestern Plains that span approximately 12,000 years: Paleoindian, Early Plains Archaic, Middle Plains Archaic, Late Plains Archaic, Late Prehistoric, and Protohistoric. The following are brief general summaries of these cultural periods.

Paleoindian (ca. 12,000 before present [B.P.] – 8,000/7,500 B.P.)

The Paleoindian period is the earliest well-documented era of human occupation in Wyoming and is represented by groups that occupied North America at the end of the last glaciation. The Northwestern Plains Paleoindian period is distinguished in the archaeological record by a sequence of large, lanceolate projectile points and specialized hide-processing tools. Corresponding with the projectile point sequence is a series of cultural complexes consisting of Clovis, Goshen, Folsom, Agate Basin, Hell Gap, Cody-Alberta, Frederick, Lusk, James Allen, and Angostura. Paleoindians subsisted primarily on large game such as mammoths and bison (of which some species are now extinct) with only rare evidence of smaller game or plant food use. Known sites of this period include campsites and kill sites, and temporary rock shelters and caves toward the end of the period.

Early Plain Archaic (ca. 8,000/7,500 – 5,000 B.P.)

The Early Plains Archaic period is roughly contemporaneous with the Altithermal climatic episode, a period marked by significantly elevated temperatures, reduced effective moisture, and a general desiccation of the landscape for a period of 2,000 to 3,000 years. During this period there was a change in projectile point styles from lanceolate to somewhat smaller corner and side-notched projectile points. Hunting and gathering wild foods were the primary subsistence practices. Known sites of this period include evidence of basin houses, communal hunting, grinding stones, hearths, storage pits, and milling basins.

Middle Plains Archaic (5,000 – 3,000 B.P.)

The Middle Plains Archaic period coincides with the appearance of the McKean Complex. This complex was named for a northeastern Wyoming site and refers specifically to a series of stylistically related projectile points. The stemmed-indented base and lanceolate McKean Complex projectile points represent a morphological change from the side and corner-notched varieties of the Early Plains Archaic period. Sites with Middle Plains Archaic tool assemblages are widespread throughout the Northwestern Plains and indicate exploitation of the complete range of habitats available in the plains and adjacent upland areas at that time. The McKean people were foragers who, in addition to hunting bison, trapped small mammals and reptiles, and collected seeds and plants. During this period, there is an abundance of roasting pits, hearths, boiling pits, structures, stone circles, and ground stone artifacts, possibly related to a more intense processing of plant resources. The use of house pits was more prominent during this period.

The Late Plains Archaic Period (3,000 – 1,500 B.P.)

During this period, climatic conditions became somewhat cooler and wetter, and there was a shift to the exploitation of larger game animals, in particular bison. The Late Plains Archaic is characterized generally by smaller, corner-notched projectile points, which replaced the McKean Complex points. The smaller points dominated most tool assemblages until the introduction of the bow and arrow around 1,500 years B.P. Cultural complexes include Pelican Lake, Yonkee, and Besant. There is some evidence for the introduction of cord-marked pottery and horticulture during the Late Plains Archaic. Broad-spectrum hunting and gathering continued throughout the period, with an increase in communal hunting of bison as evidenced by numerous kill sites in the archaeological record. Late Plains Archaic sites display a wider variety of artifacts than previous periods including basketry, woodworking debris,

sinew, hide, shell, and atlatl fragments. Similar to the previous period, Late Plains Archaic sites are found in a wide variety of ecosystems in the plains and adjacent areas.

Late Prehistoric Period (1,500 – 300 B.P.)

The beginning of the Late Prehistoric period coincides with the appearance of the bow and arrow, which replaced the atlatl and dart. During the early part of the period, projectile points generally were corner notched and smaller versions of Late Plains Archaic dart points. Over the course of the period corner-notched were replaced by side-notched forms, with tri-notching appearing at the end of the period. Subsistence focused on scheduled small and medium-game hunting, plant food gathering, and bison hunting, according to a seasonal round. Storage pits for food and other items located within structures and grinding tools are common. Artifact assemblages consist of diverse cultural materials and occasionally include pottery. Longer-term habitation sites are evident, as is increasing complexity in communal hunting systems such as bison jumps and traps. In addition, stone circles are common across the Northwestern Plains, and numerous human burial sites are known from the archaeological record.

Protohistoric Period (300 – 150 B.P. [1700s to ca. 1860])

The Protohistoric period began sometime in the 18th century when European trade goods were brought into the area, and ends with the development of the Rocky Mountain fur trade around 150 years ago. Initial trade items included glass beads, iron, brass, and the horse. The introduction of the horse to American Indians of the Plains resulted in increasingly sophisticated hunting strategies and in the ability to explore larger areas of the region. Artifact assemblages include early glass trade beads, ceramics, horse bones, and decorative items such as shell beads, tumblers, pendants, metal projectile points and knives, basketry, and carved steatite items.

The Shoshone were present in southeastern Wyoming in the 1600s and 1700s. About this time, the Crow moved into northeastern and north-central Wyoming and the Apache-Kiowas moved out of the Black Hills into southeastern Wyoming. The Apache-Kiowa migration through the Black Hills was followed by that of the Cheyenne who moved through western South Dakota and then into central Wyoming where they were joined by the Arapaho who settled in southern Wyoming. By the mid-1800s, much of the eastern and central portions of the state were occupied by nomadic Siouan-speaking tribes, primarily the Hunkpapa, Minneconjou, Brule, and Oglala.

Historic Narrative (1800s to the Present)

The first Europeans to traverse southeastern Wyoming may have been members of a party led by Robert Stuart, who crossed the continent from west to east in 1812-1813 while employed by the American Fur Company. Much of their route eventually would become the Oregon Trail. By the 1830s, French fur trappers and traders were in the area around the Laramie Mountains, and in 1834 Fort William was established by William Sublette and Robert Campbell at the confluence of the North Platte and Laramie rivers. In 1841, as Fort William began to deteriorate, it was replaced by Fort John. Fort John soon became known as Fort Laramie. In 1849, Fort Laramie was purchased by the U.S. Army and the facility was expanded to provide protection to travelers along the Oregon Trail.

Overland migration along the Oregon Trail generally is considered to have begun in 1843, although the route of the trail had become well known to missionaries, traders, trappers, and scientific exploration parties during the previous decade. Use of the trail by emigrants bound for the West Coast increased substantially, and traffic remained high until the mid-1860s. The trail not only led settlers to the Pacific Coast but also became the principal route for miners headed to the California gold fields and Mormons bound for the Great Basin. Fort Laramie's importance grew as a result of the westward migration despite the decrease in the fur trade, and the post was a principal stopping place and supply point along the route. The use of the trail declined during the Civil War and dropped dramatically with the completion of the transcontinental railroad in the late 1860s.

The spread of western settlement and increasing traffic on emigrant trails, which crossed Native American territories and hunting grounds, resulted in conflicts with Native Americans who already occupied the area. Treaties, most notably the Fort Laramie Treaty of 1851, were signed with the intent of removing tribes along the emigrant trails to reservations, and allowing for the building of trails and forts to protect settlers moving west on the Texas, Oregon, California, Mormon, Bozeman, and Bridger trails in central and eastern Wyoming. In 1868, the Wind River Indian Reservation, which currently encompasses more than 2.2 million acres, was established for the Eastern Shoshone. Ten years later, the government moved a band of Northern Arapaho from Colorado into the Wind River Valley and onto the reservation. Today, the Shoshone and Arapaho share the reservation and govern it jointly.

The livestock industry in Wyoming is considered to have originated in the 1840s during the heyday of the Oregon Trail when tens of thousands of cattle, sheep, and horses were herded across the area. With completion of the transcontinental railroad, the stock ranching industry boomed, due to access to the large markets on the East and West coasts. Cattle ranching was well established in the 1860s and the sheep industry by the 1870s. The first permanent ranches were formed in the early 1870s, with many of these becoming large by the 1880s. After the devastating blizzard of 1886, the sheep industry made significant gains, and by 1900 there were 3.3 million head of sheep in Wyoming.

Located approximately 4 miles north/northwest of the GHPA and 2.5 to 3.0 miles north of the access road is the Casper to Lander Road, which became an important transportation route between Casper and the Lander Valley in the 1880s after the arrival of the railroad in Casper. It was a freight and stagecoach route and an integral part of the development of the Wind River Basin. The road remained in use until the railroad reached Shoshoni, Riverton, and Lander in 1906.

In the 1880s, farmers began homesteading much of the open range, leading to conflicts with ranchers over fencing. By 1910, much of the range in Wyoming was fenced in order to establish boundaries and prevent livestock from straying. The last great period of homesteading occurred between the end of World War I and the mid-1930s in response to passage of the Stock-Raising Homestead Act of 1916, which expanded the size of homesteads. The Great Depression and the droughts that occurred at the same time led to the abandonment of many farms and the outmigration of a significant portion of Wyoming's population. Many of the homesteads were bought out in the 1930s and 1940s to create larger farms that used mechanized equipment.

Uranium discoveries northeast of Casper near Pumpkin Buttes led to the development of 5 uranium processing plants. By 1955, the Atomic Energy Commission established a regional buying station for yellowcake in Riverton. The uranium boom helped Riverton's economy and the town was soon known as Wyoming's "uranium capitol." The Lucky Mc uranium mine completed the state's largest uranium mill in the center of the Gas Hills Mining District in 1958. The mill annually produced 700,000 pounds of uranium concentrate. Production slowed during the 1960s; however, exploration work continued and then exploded during the 1970s in response to the spiking yellowcake prices and the growing industry. The uranium industry plummeted in the early 1980s because of the decline in the price of yellowcake. Much of the uranium ore in Wyoming, as well as in other areas of the U.S., comes from deposits in sandstone, which tend to be of lower grade compared to uranium ore found in other countries. Because of the lower grade, many of the uranium deposits became uneconomical when the price of uranium declined during this time.

Oil production continued strong, peaking both nationally and in Wyoming in 1970. All but a handful of refineries closed in the 1970s and 1980s. Although most oil fields in Wyoming are aging, oil production remains important to the state. However, oil no longer is the primary energy mineral produced in the state.

3.2.1.4 Cultural Resources Inventories

The earliest cultural resources investigations within and near the GHPA were conducted from 1976 to 1979. These investigations were conducted by the Office of the Wyoming State Archaeologist and

Powers Elevation Company, Inc. Due to changing standards and guidelines in cultural resources inventories, recording techniques, and NRHP eligibility assessment, investigations conducted prior to 1981 generally are not accepted as adequate today. In the 1980s and 1990s, 3 relatively large Class III inventories were conducted within the GHPA, as well as follow-up site revisits requested by the BLM. These 3 inventories are briefly discussed in the following paragraphs.

In 1980, the Wyoming State Archaeologist inventoried 1,100 acres within the GHPA (Hauff et al. 1982). A total of 19 archaeological sites were recorded during the inventory. The 19 sites consisted of 15 prehistoric lithic scatters, 2 prehistoric lithic scatters with stone circles, 1 prehistoric lithic scatter with stone circles and historic corrals, and 1 historic trailer. Of these sites, 14 were determined not eligible for the NRHP with concurrence from the Wyoming SHPO; the eligibility of the remaining 5 sites was undetermined at the time.

In 1992, a Class III cultural resources inventory was conducted in the GHPA by Pronghorn Archaeological Services (PAS) (Phillips 1993). Approximately 1,600 acres of the GHPA were inventoried. The inventory resulted in the recordation of 14 sites and 4 isolated artifacts. Of the 14 sites, 1 was recommended as eligible for the NRHP by the field archaeologist, 4 were unevaluated pending subsurface testing, and 9 were recommended as not eligible for the NRHP. The eligible site consisted of several stone circles and related cairns (a man-made pile or stack of stones used as a marker) and the 4 unevaluated sites consisted of 3 prehistoric camps and 1 lithic scatter. The 9 sites recommended as not eligible consisted of 6 lithic scatters, 2 prehistoric camps, and 1 stone circle.

In addition to the inventory, PAS re-examined the 19 sites previously recorded by the OSWA in 1980 (Phillips 1993). All but 3 of the re-examined sites were recommended as not eligible for listing on the NRHP. The 3 sites had the potential to contain buried prehistoric deposits and were considered unevaluated pending subsurface testing.

In 1997, an additional 2,840 acres of the GHPA were inventoried to Class III standards by PAS (Phillips 1993). The inventory resulted in the recordation of 20 prehistoric sites and 14 isolated artifacts; 3 previously recorded sites were relocated. Only 1 of the sites was recommended as eligible for listing in the NRHP. The 20 prehistoric sites consisted of 8 open camps, 3 isolated stone circles (2 with associated debitage), 6 isolated hearth features, and 3 lithic scatters. One of the prehistoric open camps also contained historic debris. Of the 3 previously recorded sites, 2 were open camps and 1 was an excavated hearth. The single eligible site was identified as a prehistoric open camp with associated stone circles.

In 2011, Larson-Tibesar Associates (LTA) conducted archaeological investigations in the GHPA which included evaluation of 34 previously recorded unevaluated prehistoric sites, Class III inventory of previously unsurveyed areas, a visual assessment of the Casper to Lander Road, a sample survey of previously inventoried areas, and an evaluation of the Gas Hills as a historic mining district (Larson et al. 2012). During evaluation of the 34 previously recorded sites it was discovered that 4 of the sites are located outside the GHPA; no further work was conducted at these sites. The remaining 30 sites are listed in **Table 3.2-1**. Of these sites, 10 could not be relocated during the investigations. Evaluation of the remaining 20 sites resulted in the recommendation of 15 as not eligible for the NRHP and 5 as eligible under Criterion D. Avoidance is recommended for the 5 eligible sites, 2 of which are located just outside the boundaries of the proposed mine units (Larson et al. 2012).

It should be noted that 9 of the previously recorded unevaluated sites contain stone features which typically are of concern to Native American tribes. In April 2007, the BLM conducted tribal consultation at 3 of the sites (48NA420/48FR917, 48FR3234, 48NA2151/48FR3235). At that time, it was agreed that no drilling would occur within 100 feet of 48FR420/48FR917 and within 300 feet of the other sites. In addition, it was agreed that if drilling was proposed on areas level with or above 48FR3235/48NA2151, additional consultation may be necessary.

Table 3.2-1 Previously Recorded Unevaluated Sites Located Within the GHPA

Site Number	NRHP Eligibility Evaluation	Cultural Affiliation/Site Type
48NA420/48FR917	Eligible (Tribal site visit 2007)	Late Prehistoric and Late Archaic occupation areas with stone circles; historic artifacts
48NA2151/FR3235	Could not be relocated (exact location of the site needs to be resolved – potentially eligible) (Tribal site visit 2007)	Unknown prehistoric stone circles and lithic scatter
48FR144	Not Eligible	Unknown prehistoric lithic scatter
48FR145	Not Eligible	Possible Late Archaic lithic scatter with fire cracked rock; historic debris
48FR234	Could not be relocated	Unknown prehistoric lithic scatter
48FR930	Not Eligible	Unknown prehistoric lithic scatter
48FR931	Not Eligible	Late Archaic lithic scatter
48FR3234	Not Eligible (Tribal site visit 2007)	Unknown prehistoric stone circle
48FR3236 [a]	Eligible	Unknown prehistoric stone circles
48FR3239	Not Eligible	Unknown prehistoric lithic scatter
48FR3240	Not Eligible	Unknown prehistoric stone circles and lithic scatter
48FR3864	Could not be relocated	Unknown prehistoric lithic scatter
48FR3865	Could not be relocated	Unknown prehistoric lithic scatter
48FR3866 [a]	Eligible	Unknown prehistoric stone circles and lithic scatter
48FR3867	Could not be relocated (may have been misplotted - site description is similar to 48FR3866)	Unknown prehistoric stone circles and lithic scatter
48FR3868	Could not be relocated	Unknown prehistoric hearth
48FR3869	Could not be relocated	Unknown prehistoric lithic scatter with hearths
48FR3870	Not Eligible	Unknown prehistoric stone circle
48FR3871	Not Eligible	Unknown prehistoric lithic scatter with fire cracked rock
48FR3872	Could not be relocated	Unknown prehistoric hearth
48FR3873	Not Eligible	Unknown prehistoric lithic scatter
48FR3874	Could not be relocated	Unknown prehistoric stone circle, hearth, and lithics
48FR3875	Not Eligible	Unknown prehistoric hearth
48FR3876[a]	Eligible	Late Archaic lithic scatter
48FR3877	Could not be relocated	Unknown prehistoric hearth
48FR3878	Not Eligible	Unknown prehistoric hearth
48FR3879	Not Eligible	Unknown prehistoric stone circle

Table 3.2-1 Previously Recorded Unevaluated Sites Located Within the GHPA

Site Number	NRHP Eligibility Evaluation	Cultural Affiliation/Site Type
48FR3880	Not Eligible	Unknown prehistoric lithic scatter
48FR3881 [a]	Eligible	Unknown prehistoric stone circles
48FR3882	Not Eligible	Unknown prehistoric stone circle

[a] Located outside of the proposed mine unit boundary.

Source: Larson et al. 2012.

LTA also completed Class III inventory of 2,655 acres of land within the GHPA that had not been previously inventoried to Class III standards (Larson et al. 2012). As a result of the inventory, 11 new sites and 24 previously recorded sites were identified within the GHPA (**Table 3.2-2**). Of these, 3 sites (48NA420/48FR917, 48NA4985, 48FR6903) are recommended as eligible for inclusion in the NRHP; the remaining 10 sites are recommended as not eligible. Avoidance is recommended for the 3 eligible sites, 2 of which are located outside the boundaries of the proposed mine units. Of the sites listed in the table, 2 (48NA420/48FR917, 48FR6903) contain stone circles, which typically are of concern to Native American tribes.

Table 3.2-2 Sites Recorded in New Inventory areas within the GHPA

Site Number	NRHP Eligibility Evaluation	Cultural Affiliation/Site Type
48NA420/48FR917 [a]	Eligible	Late Prehistoric and Late Archaic occupation areas with stone circles; historic artifacts
48NA4981/48FR6906	Not Eligible	Unknown prehistoric lithic scatter; historic debris
48NA4982	Not Eligible	Late Prehistoric lithic scatter
48NA4983	Not Eligible	Unknown prehistoric lithic scatter
48NA4984	Not Eligible	Unknown prehistoric hearth
48NA4985 [b]	Eligible	Archaic occupation area with datable features and diagnostic artifact
48FR931 [a]	Not Eligible	Late Archaic lithic scatter
48FR6902	Not Eligible	Unknown prehistoric lithic scatter
48FR6903 [b]	Eligible	Late Prehistoric stone circles, hearths, and lithics
48FR6904	Not Eligible	Unknown prehistoric lithic scatter
48FR6905/48NA4980	Not Eligible	Unknown prehistoric lithic scatter; historic Thunderbird Mine
48FR6907	Not Eligible	Unknown prehistoric lithic scatter; historic debris
48FR6910	Not Eligible	Unknown prehistoric lithic scatter

[a] Also in **Table 3.2-1**.

[b] Located outside of the proposed mine unit boundary.

Source: Larson et al. 2012.

A visual assessment of the Casper to Lander Road (48FR1783/48NA4218) was conducted by LTA as part of the 2011 archaeological investigations. An initial desktop viewshed analysis indicated a small

portion of the GHPA is visible from the road, generally along the upper, north facing slopes of the Beaver Divide which includes some parts of the southern segment of Mine Unit 3 and southern edge of the eastern portion of Mine Unit 2. Following the desktop analysis, the segment of the Casper to Lander Road from which the GHPA is visible was visited and evaluated for NRHP eligibility. The segment of the road has been destroyed and therefore is recommended as non-contributing to the overall eligibility of the road.

In 2011, LTA conducted a sample survey of 3 previously inventoried areas within the GHPA. The purpose of the survey was to verify the results of prior inventories in terms of accuracy and conformation to current Class III inventory standards. Total acreage of the 3 areas was 5,341 acres.

Sampling results of the first area indicate relatively consistent findings between LTA and previous inventories conducted by PAS. The only difference between the 2 inventories was the documentation by LTA of 1 new site with stone circles and a multi-artifact isolated resource (IR), and the inability to locate a previously recorded site. None of the newly recorded sites are recommended as eligible for the NRHP.

Results of the sampling survey for the second area indicate differences in terms of higher site/IR counts for LTA (11 sites/multi-artifact IRs) compared to site/IR counts for PAS (5 sites/multi-artifact IRs). LTA documented 3 new sites and 4 new multi-artifact IRs. Of the newly recorded sites, only 1 is recommended as eligible for the NRHP.

Of the 3 areas sampled, the third area had been the most disturbed by previous mining and reclamation. Sampling results indicate differences in terms of higher site/multi-artifact IR counts for LTA (9 sites/ multi-artifact IRs) compared to site/IR counts for the OWSA (2 sites). LTA documented 2 new sites and 4 new multi-artifact IRs. None of the newly recorded sites are recommended as eligible for the NRHP.

In sum, LTA encountered 16 archaeological sites during the sampling survey, of which 12 are previously recorded sites and 4 are newly recorded sites (**Table 3.2-3**). The majority of the sites contain prehistoric lithic scatters with unknown cultural affiliation. Of the 16 sites, 7 are recommended as eligible for the NRHP and the remaining 9 sites are recommended as not eligible.

Table 3.2-3 Sites Encountered During the Sample Survey

Site Number	Previously Recorded/Newly Recorded	NRHP Eligibility Evaluation	Cultural Affiliation/Site Type
48FR144 [a]	Previously Recorded	Not Eligible	Unknown prehistoric lithic scatter
48FR145 [a]	Previously Recorded	Not Eligible	Possible Late Archaic lithic scatter with fire cracked rock; historic debris
48FR930 [a]	Previously Recorded	Not Eligible	Unknown prehistoric lithic scatter
48FR3232	Previously Recorded	Eligible	Complex with unknown lithic scatter, hearths, and stone circles
48FR3234 [a]	Previously Recorded	Not Eligible	Unknown prehistoric stone circle
48FR3238	Previously Recorded	Not Eligible	Unknown prehistoric lithic scatter
48FR3866 [a, b]	Previously Recorded	Eligible	Unknown prehistoric stone circles and lithic scatter
48FR3871 [a]	Previously Recorded	Not Eligible	Unknown prehistoric lithic scatter with fire cracked rock
48FR3879 [a]	Previously Recorded	Not Eligible	Unknown prehistoric stone circle

Table 3.2-3 Sites Encountered During the Sample Survey

Site Number	Previously Recorded/Newly Recorded	NRHP Eligibility Evaluation	Cultural Affiliation/Site Type
48FR3881 [a,b]	Previously Recorded	Eligible	Unknown prehistoric stone circles
48FR6908	Newly Recorded	Not Eligible	Unknown prehistoric lithic scatter
48FR6909	Newly Recorded	Not Eligible	Unknown prehistoric stone circle
48FR6911 [b]	Newly Recorded	Eligible	Late Archaic prehistoric lithic scatter
48NA420/48FR917 [a]	Previously Recorded	Eligible	Late Prehistoric and Late Archaic occupation areas with stone circles; historic artifacts
48NA2151/48FR3235 [a, b]	Previously Recorded	Eligible	Unknown prehistoric stone circles and lithic scatter
48NA4987 [b]	Newly Recorded	Eligible	Unknown prehistoric stone circle and lithic scatter

[a] Also in **Table 3.2-1.**

[b] Located outside of or adjacent to the proposed mine unit boundary.

Source: Larson et al. 2012.

Based on previously and recently conducted cultural resources inventories, a total of 78 cultural resources are located within the GHPA. Of these, 23 are eligible for listing on the NRHP and 55 are not eligible. A total of 9 NRHP-eligible sites and 16 ineligible sites are located in proposed disturbance areas and could be directly affected by ground-disturbing activities associated with the Proposed Action Alternative. For those sites located in proposed disturbance areas, 9 would require Native American consultation to determine eligibility.

3.2.2 Native American Concerns

Ethnographic resources are associated with the cultural practices, beliefs, and traditional history of a community. Examples of ethnographic resources include places in oral histories or traditional places, such as particular rock formations, the confluence of 2 rivers, or a rock cairn; large areas, such as landscapes and viewscapes; sacred sites and places used for religious practices; social or traditional gathering areas, such as dance areas; natural resources, such as plant materials or clay deposits used for arts, crafts, or ceremonies; and places and natural resources traditionally used for non-ceremonial uses, such as trails or camping locations.

3.2.2.1 Regulatory Framework

Federal law and agency guidance require the BLM to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by actions on BLM-administered lands. This consultation includes the identification of places (i.e., physical locations) of traditional cultural importance to Native American tribes. Places that may be of traditional cultural importance to Native American people include, but are not limited to, locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners go, either in the past or the present, to perform ceremonial activities based on traditional cultural rules or practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes, may be taken. Some of these locations may be considered sacred to particular Native American individuals or tribes.

In 1992, the NHPA was amended to explicitly allow that “properties of traditional religious and cultural importance to an Indian tribe may be determined to be eligible for inclusion in the NRHP.” If a resource has been identified as having importance in traditional cultural practices and the continuing cultural identity of a community, it may be considered a traditional cultural property. The term “traditional cultural property” first came into use within the federal legal framework for historic preservation and cultural resource management in an attempt to categorize historic properties containing traditional cultural significance. To qualify for nomination to the NRHP, a traditional cultural property must be more than 50 years old, must be a place with definable boundaries, must retain integrity, and must meet certain eligibility criteria as outlined for cultural resources in the NHPA.

In addition to NRHP eligibility, some places of cultural and religious importance also must be evaluated to determine if they should be considered under other federal laws, regulations, directives, or policies. These include, but are not limited to, the Native American Graves Protection and Repatriation Act of 1990, AIRFA, ARPA, and EO 13007 of 1996, Indian Sacred Sites.

3.2.2.2 Native American Consultation

In compliance with the NHPA, the BLM initiated government-to-government consultation for the Gas Hills Project on May 6, 2011, by sending letters to the following federally recognized tribes: Ute Indian Tribe, Northern Arapaho Tribe, Eastern Shoshone Tribe, Crow Nation, Northern Cheyenne Tribe, Shoshone-Bannock Tribe, Rosebud Sioux Tribe, Oglala Sioux Tribe, Cheyenne River Sioux Tribe, Lower Brule Sioux Tribe, Fort Peck Assiniboine Sioux Tribes, Standing Rock Sioux Tribe, Crow Creek Sioux Tribe, and Yankton Sioux Tribe. The letters were sent to inform the various tribes of the Gas Hills Project and invite the tribes to comment on the proposed undertaking. Additionally, the letters included a request for information on any resources or places of traditional, religious, and cultural importance to the tribes that may be located in the Gas Hills area. Included with the letters was a map of the GHPA and a response form for the tribes to indicate their level of interest and return to the BLM. To date, only the Standing Rock Sioux Tribe and Northern Cheyenne Tribe have responded to the letter. Both tribes are interested in participating in the consultation efforts for the Project.

On May 7, 2012, the BLM sent a second letter to the above-listed federally recognized tribes. The letter included a description of the project area, information on previously and recently conducted cultural resources inventories, and a request for comments and/or concerns regarding the Gas Hills ISR Project. Attached to the letter were a: 1) project map; 2) figure showing an example of a typical mine unit; and, 3) response form on which the tribes could indicate their interest in participating in the consultation efforts, and their availability to participate on a conference call to discuss the project. To date, the Standing Rock Sioux Tribe, Crow Nation, and Ute Indian Tribe have responded to the letter.

From May 16 to June 5, 2012, the BLM conducted follow-up calls to the 14 federally-recognized tribes. The BLM called the tribes to verify receipt of the May 7, 2012, letter and to invite the tribes to participate on a conference call tentatively scheduled for mid-June 2012.

In early June 2012, the BLM invited the 14 federally-recognized tribes listed above, plus the Sisseton-Wahpeton Oyate Tribe, to participate on a conference call scheduled for June 13, 2012. Of the 15 tribes, 6 tribes were able to participate on the call. The 6 tribes included the Northern Arapaho Tribe, Shoshone-Bannock Tribe, Sisseton-Wahpeton Oyate Tribe, Rosebud Sioux Tribe, Yankton Sioux Tribe, and Standing Rock Sioux Tribe. During the call, the BLM discussed the results of cultural resources inventories conducted in the GHPA and tentative dates for two week-long field tours. Tentative dates for the field tours were the week of August 6 and the week of August 20, 2012. If needed, an alternative week for a field tour would be the week of September 17, 2012. Some of the tribal representatives on the call expressed concern that the archaeologists conducting the previous inventories may have missed sites of tribal concern. The field tours would provide an opportunity for the tribes to tour the GHPA and identify sites that may have been missed.

From September 17 to 21, 2012, the BLM conducted a field tour of the GHPA. A total of 6 tribes participated in the field tour. These 6 tribes included the Northern Arapaho Tribe, Eastern Shoshone Tribe, Crow Nation, Oglala Sioux Tribe, Fort Peck Assiniboine Sioux Tribes, and Sisseton-Wahpeton Oyate Tribe. During the field tour, tribal representatives identified sites of concern that would require reroutes and avoidance by the Project, including previously recorded sites as well as newly identified sites. Tribal consultation will be ongoing to identify additional sites of concern, and to determine avoidance distances and/or mitigation measures required for each site.

Located approximately 8 miles north of the GHPA is the Castle Gardens Rock Art Site. The site contains a large number of prehistoric drawings estimated to date from the Late Prehistoric Period. Several styles of art are evident, and many excellent shield motif representations are present. It is assumed that the functions of the drawings are concerned mostly with spiritual beliefs or a record of important events. The site is considered to be a spiritual site to the Eastern Shoshone, Northern Arapaho, and other tribes, and modern traditional use of the site has been documented as well. Castle Gardens Rock Art Site is listed on the NRHP and has been nominated for Areas of Critical Environmental Concern (ACEC) designation.

Any specific information provided by the tribal groups concerning Native American traditional use and/or sites of cultural and religious importance in or near the GHPA would remain confidential. At this time, consultation with the Native American groups is ongoing and would continue up to and including Project construction.

3.3 Geology

3.3.1 Physiography and Topography

The Project is located in the Wind River Basin and is part of the Wyoming Basin physiographic province (Fenneman 1928). The Wyoming Basin is a 40,000 square mile area located in central and southwestern Wyoming and parts of northwestern Colorado and is characterized by rolling plains, dissected badlands, and small mountain ranges (Howard and Williams 1972). The Wind River Basin is bounded by the Owl Creek Mountains to the north, the Granite Mountains to the south, the Wind River Mountains to the west, and to the east a gentle uplift referred to as the Casper Arch (Wyoming State Geological Survey [WSGS] 2011). The GHPA is located on the southern edge of the Wind River Basin just to the north of the Granite Mountains.

Important physiographic features in the Gas Hills area include the Gas Hills, Rattlesnake Hills, Black Mountain, and the Beaver Rim (**Figure 3.3-1**). The Rattlesnake Hills is a 15 mile-long northwest to southeast trend of hills east of the GHPA which range up to 8,200 feet amsl at Garfield Peak. Black Mountain, which tops out at about 8,000 feet amsl southeast of the GHPA. An important physiographic feature in the GHPA is the Beaver Rim or Beaver Divide, prominent escarpments that trend from the southern extent of the Wind River Mountains to the Rattlesnake Hills and forms the southern physiographic boundary of the Wind River Basin (Soister 1968). The Beaver Rim skirts the south boundary of the GHPA and the change in elevation along the escarpment varies from 500 to 700 feet. The Beaver Rim is a divide between north-flowing drainages to the north and south-flowing drainages to the south. The Gas Hills, for which the mining district is named, are located just to the northwest of the GHPA and are composed of hogbacks of steeply dipping Cretaceous rocks (Love 1954).

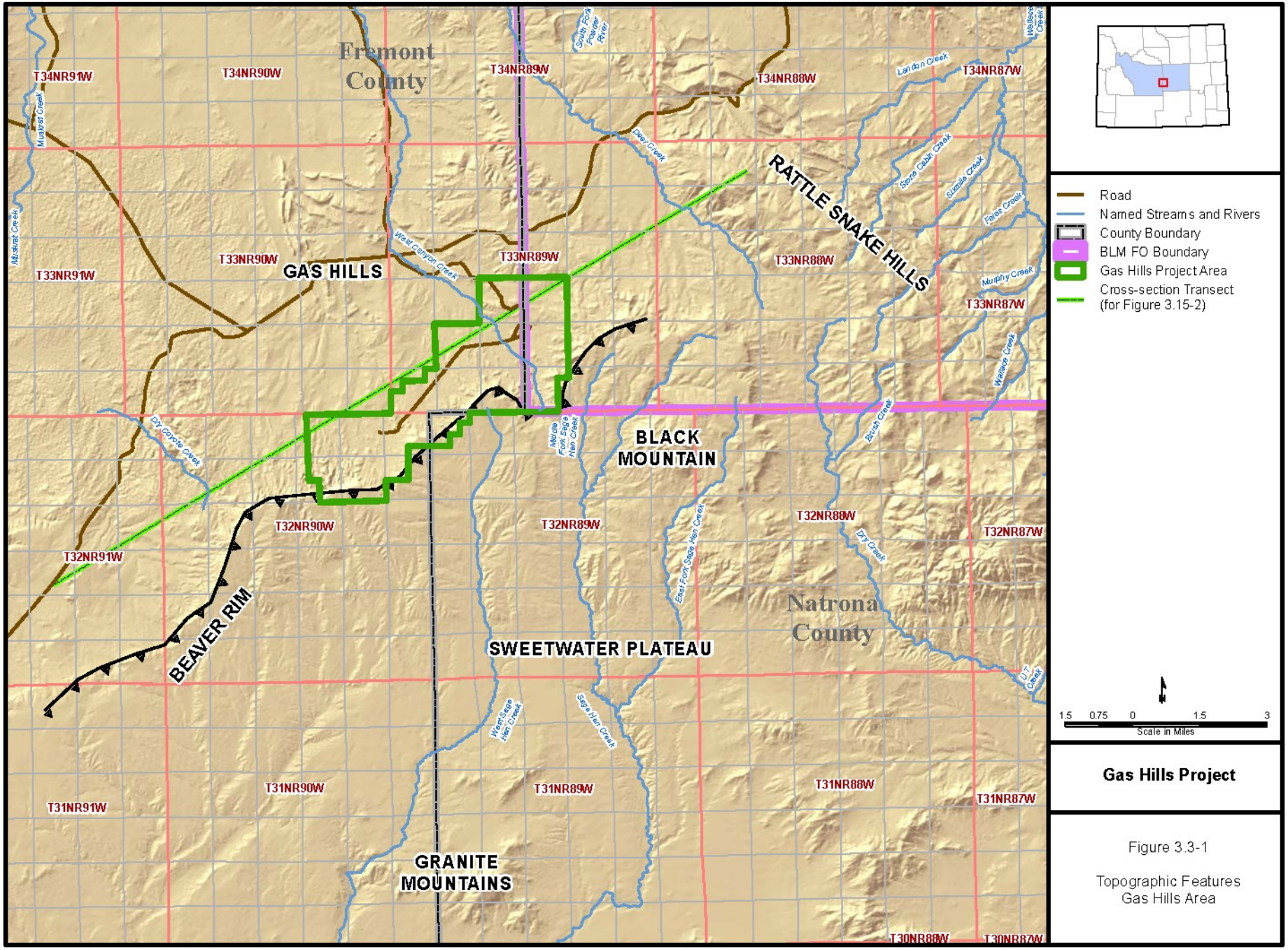
The topography north of the Beaver Rim consists of hummocky low hills and deeply dissected northwest trending drainages. Elevations in the GHPA range from around 7,400 feet amsl at the top of the Beaver Rim to around 6,700 feet amsl along the north side of the GHPA. The topography of the GHPA is dominated by the steep slopes of the Beaver Rim on the south to gentler sloping ground north of the escarpment. South of the GHPA is an area that slopes gently to the south and is referred to as the Sweetwater Plateau (Soister 1968).

3.3.2 Regional Geology

The Wind River Basin is a large asymmetric synclinal basin approximately 200 miles long and 90 miles wide. The basin contains about 30,000 feet of sedimentary rock (Jensen 1972) ranging in age from Cambrian to recent. Tertiary-aged deposits cover a large portion of the basin and older Paleozoic and Mesozoic rocks are exposed on the edges of the basin or in isolated uplifts within the basin (Love and Christiansen 1985).

The surficial deposits in the GHPA are alluvium, colluvium, and landslide debris (Van Houten 1964). The alluvium and colluvium are found primarily along the floodplains of drainages and low lying surfaces and consist of sand and silt sized material derived from the Tertiary bedrock in the area. Landslide deposits are present at the base of the Beaver Rim and are composed of large rotated blocks along the edge of the rim or mixed earth flows and rock slides.

Bedrock deposits within the mine permit boundary consist primarily of Tertiary rocks and a small outcropping of Paleozoic rocks in the northeast part of the GHPA. **Table 3.3-1** lists the rocks that are exposed within the GHPA, rocks that are exposed in the immediate vicinity (Gas Hills and Rattlesnake Hills), and rocks buried beneath the Tertiary beds that cover the GHPA. **Figure 3.3-2** shows the bedrock geology in the GHPA.



Gas Hills Project

Figure 3.3-1

Topographic Features
Gas Hills Area

Table 3.3-1 Stratigraphic Chart, GHPA

Era	System	Series	Age (Ma[a])	Formation[b]/ Map Symbol	Description	Thickness (feet)
Cenozoic	Quaternary	Holocene	<0.015	Alluvium[b]/**Qa**	Gravel, sand, silt, clay.	Not determined
				Landslide Material[b]/**Qls**	Mixed material composed of blocks, talus, and earth flows composed of material eroded from the Beaver Rim.	Not Determined
		Pleistocene	0.015-2.6	Pediment Gravels/**Qt**	Gravels, cobbles and coarse sand derived from granite.	Less than 15
	Tertiary	Miocene	16-26	Split Rock Formation[b]/ **Tm**	Conglomerate, sandstone, and tuff.	Up to 100
		Oligocene	31-36	White River Formation[b]/ **Twr**	Tuff and tuffaceous bentonitic mudstone, sandstone, and conglomerate.	Up to 450
		Eocene	45-49	Wagon Bed Formation[b]/ **Twb**	Bentonitic and locally tuffaceous mudstone and sandstone, and volcanic sandstone, and conglomerate.	500
			38-49	Tertiary Intrusives/**Ti**	Alkalic igneous rocks, dacite, and quartz latite.	Undetermined
			49-55	Wind River Formation[b]/ **Twdr**	Lenticular mudstone, sandstone, and conglomerate, locally tuffaceous in upper part.	800+

Table 3.3-1 Stratigraphic Chart, GHPA

Era	System	Series	Age (Ma [a])	Formation [b]/ Map Symbol	Description	Thickness (feet)
Mesozoic	Cretaceous	Upper	82-87	Cody shale/**Kc**	Soft gray shale becoming sandy in the upper part.	3,000+
		Upper	87-95	Frontier Formation/**Kf**	Sandstone interbedded black shale with tuff and bentonite beds.	580
		Lower	95-100	Mowry Shale-Muddy Sandstone-Thermopolis Shale/**Kmt**	Dark gray to black bentonitic shale and sandstone and interbedded sandstone and shale.	650
	Lower Cretaceous-Upper Jurassic		100-140	Cloverly and Morrison /**KJ**	Sandstone and conglomerate with interbedded claystone and sandstone in lower part. Morrison: Fine- to very fine-grained well sorted sandstone.	280
	Jurassic - Triassic		140-205	Sundance and Nugget Sandstones/ **JTR**	Sundance: Fine-grained sandstone and green shale. Nugget: Fine- to coarse-grained hard calcareous sandstone.	410
	Triassic		205-240	Chugwater Group/**TRc**	Interbedded red sandstone, siltstone, shale, and limestone.	1,000

Table 3.3-1 Stratigraphic Chart, GHPA

Era	System	Series	Age (Ma[a])	Formation[b]/ Map Symbol	Description	Thickness (feet)
Paleozoic	Permian		250-280	Phosphoria Formation[b]/**Pp**	Dolomite with interbedded red shale and anhydrite.	325
	Pennsylvanian	Middle	290-310	Tensleep Sandstone[b]/ **PM**	Fine- to coarse-grained sandstone with cherty dolomite.	200
		Lower	310-340	Amsden Formation[b]/ **PM**	Red and green shale, cherty dolomite, and sandstone.	260
	Mississippian	Lower	340-360	Madison Limestone[b]/ **Mm**	Limestone; massive to thick-bedded.	300
	Cambrian	Middle	500-570	Gros Ventre[b]/ **Cfg**	Reddish brown siltstone and sandstone with limestone pebble conglomerate.	400
				Flathead[b]/**Cfg**	Interbedded coarse-grained sandstone and conglomerate derived from granitic rocks.	220
Precambrian			2,600	Not defined/**PC**	Granite, granitic gneiss, schist, and pegmatites.	Not known

[a] Ma = Million years ago.

[b] Exposed within the GHPA.

Note: Separation of geological layers (Systems or Series) that uncomfortably overlie each other are indicated by the dashed line in the table.

Sources: Cameco (1996); Finn (2007); Love (1970, 1954); Love and Christiansen (1985), Love et al. (1993); Soister (1967).

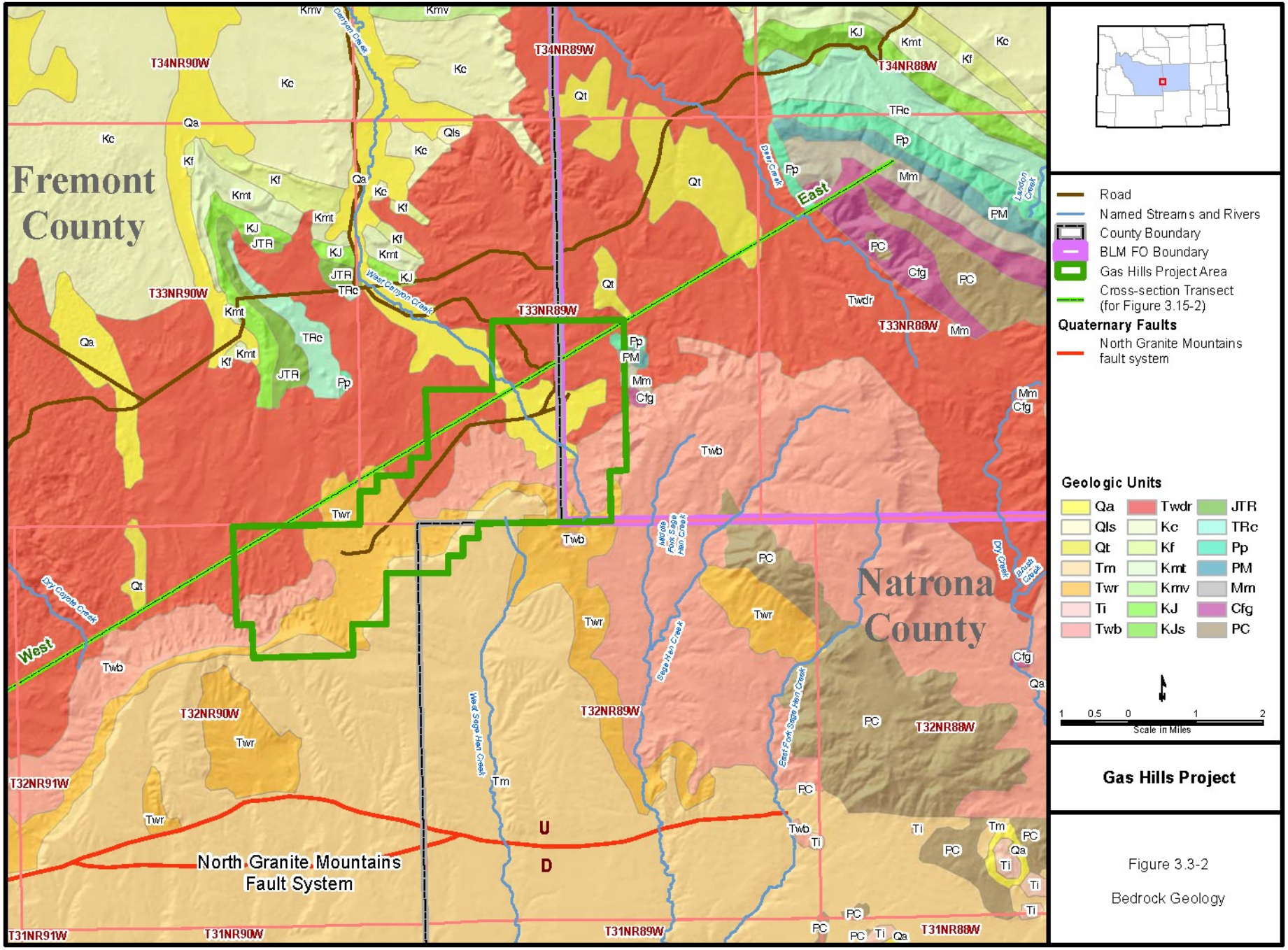


Figure 3.3-2

Bedrock Geology

The Tertiary rocks in the GHPA area are up to several hundred feet thick and cover a rugged pre-Tertiary erosion surface formed on Mesozoic and Paleozoic rocks (Love 1954; PRI 2009). The Wind River Formation generally outcrops at the base of the Beaver Rim, while the Wagon Bed Formation forms the lower slopes of the escarpment (Soister 1967). The White River and Split Rock formations form the upper layers of the Beaver Rim. The rocks beneath the Tertiary beds in the GHPA range in age from upper Cretaceous to Triassic and have been folded into a series of northwest-southeast trending en-echelon anticlines and synclines and form angular unconformities with the overlying Tertiary beds (PRI 2009).

The major structural elements in the region were created during the formation of the Rocky Mountains (the Laramide Orogeny) that occurred from late Cretaceous to early Tertiary. One of the largest uplifts occurred in early Eocene and created the Granite Mountains (Love 1970). The Wind River and Wagon Bed Formations were derived from material that was shed from the Granite Mountains as uplift occurred until Middle-Eocene time. During the Oligocene, vigorous volcanic activity to the northwest of the GHPA formed the modern Rattlesnake Hills. Erosion of the volcanic deposits resulted in the transportation of volcanic material over many miles, in addition to thick air-borne ash, which was deposited over many thousands of square miles. The White River Formation consists of volcanic debris plus slightly reworked volcanic ash almost 1,000 feet thick (Love 1970). The Split Rock Formation was deposited in a basin formed by subsidence of the Granite Mountains block due to crustal extension during the Miocene. The Split Rock Formation is largely composed of sand deposited by wind and water that attained a maximum thickness of nearly 3,000 feet, burying all but the highest peaks of the Granite Mountains. Although subsequent uplift in the Pleistocene resulted in erosion of some of the material, the Granite Mountains are still largely buried in detritus that surrounds the peaks. This later episode of Pleistocene uplift and erosion was responsible for creating the Beaver Rim and the southward tilt of the Sweetwater Plateau, resulting in the present-day drainage flow pattern.

Important structural features in the Gas Hills area include the North Granite Mountains fault system, Rattlesnake Hills, and the Gas Hills. The trace of the North Granite Mountains fault system is about 2 to 3 miles south of the GHPA (Love 1970) (**Figure 3.3-2**). The fault system consists of 60 miles of east-west trending normal faults bounding the north side of the Granite Mountains. The fault zone is believed to have been active in early Eocene during the major growth period of the Granite Mountains and again in the Pliocene when the mountain range subsided. The Rattlesnake Hills, just 3 miles northeast of the GHPA, is an anticline where Mesozoic and Paleozoic rocks are exposed. Along the crest of the hills and in a 150-square mile volcanic field around the Rattlesnake Hills are volcanic rocks in the form of dikes, sills, and plugs (Carey 1954). The volcanism is believed to have begun in middle Eocene and had ceased by the end of Eocene. The Gas Hills consist of hogbacks of tightly folded steeply dipping Cretaceous rocks (Love 1954). The geologic structure that forms the Gas Hills is referred to as the Dutton Basin Anticline, an exhumed structure that provides evidence of the northwest-southeast trending structures of the pre-Tertiary rocks beneath the GHPA and plunge to the northwest along regional dip into the Wind River Basin (Berg and Thompson 1957; Soister 1967). Precambrian granitic rocks are exposed in the southern part of the Rattlesnake Hills and comprise the main body of Black Mountain to the southeast of the GHPA.

3.3.3 Geologic Hazards

3.3.3.1 Seismic Hazards

<u>Seismicity</u>

Seismicity concerns the intensity, frequency, and location of earthquakes in a given area. Since 1973, there have been 25 earthquakes greater than 2.0 magnitude within 60 miles of the Project. The strongest earthquakes recorded were 4.8 magnitude quakes that took place in 1973 and 1975 approximately 15 miles west and southwest of the GHPA (Case et al. 2003, 2002; U.S. Geological Survey [USGS] 2011a). The data indicate that the seismic potential of the area is low.

Faults

Faults are dislocations of earth material where crustal blocks on opposite sides of the faults have moved in relation to each other (USGS 2009). Rapid slippage of blocks of earth past each other can cause energy to be released, resulting in an earthquake. An active fault is a fault where movement has occurred in the last 10,000 years and a potentially active fault is a fault where movement has possibly occurred during Quaternary time or the last 1.6 million years. The closest potentially active fault zone is the South Granite Mountains fault zone located approximately 25 miles south of the GHPA. The 80 mile-long fault zone trends west to east. Movement within the last 15,000 years has been documented in the Green Mountain area, along the Ferris Mountains and in the Muddy Gap area (USGS 2006).

There are other recognized fault zones in the Granite Mountains region, but there is no conclusive evidence that these features are active. The North Granite Mountains fault system may have been active from the Pliocene until early Quaternary (less than 1.6 Ma), but there is no evidence of movement within the last 10,000 years. The Split Rock Syncline, located north of and parallel to South Granite Mountains fault system, is a structure that was likely formed in response to uplift on the South Granite Mountains fault system It may have been active into Quaternary, but there is no conclusive evidence of movement within the last 10,000 years (USGS 2006).

Ground Motion

Ground motion hazards result when the energy from an earthquake is propagated through the ground. The USGS ground motion hazard mapping indicates that potential ground motion hazard in the GHPA is low. The hazard map used estimates of peak ground acceleration expressed as a percentage of the acceleration of gravity with a 10 percent probability of exceedence in 50 years (Petersen et al. 2008). Peak acceleration from a probable maximum earthquake event for the area is estimated to be less than 6 percent of gravity reference.

3.3.3.2 Landslides

Landslide is a term used for various processes involving the movement of earth material down slopes (USGS 2004). Landslides can occur in a number of different ways in different geological settings. Large masses of earth become unstable and by gravity begin to move downhill. The instability can be caused by a combination of factors including steep slopes, periods of high precipitation, undermining of support by natural processes (stream erosion), or unintentional undercutting or undermining the strength of unstable materials by construction of roads and structures.

Landslide deposits have been identified at the base of the Beaver Rim (WSGS 2004) (**Table 3.3-1**). Erosion along the steep escarpment results in instability at the edge and mass earth movements occur. The landslide deposits are limited to the slopes of the Beaver Rim (**Figure 3.3-3**). North of the rim, there are isolated rock slides and block slides associated with steep slopes.

3.3.4 Mineral Resources

Important mineral resources in the Gas Hills include: uranium, oil, gas, and bentonite. Recently, gold was discovered in the Rattlesnake Hills and current exploration is attempting to determine the commercial viability of the precious metal deposits. The following subsections provide a description of the mineral resources within the GHPA including details on the geology and mineralization of the uranium deposits. A detailed description of the geology and hydrogeology of uranium-bearing zones is presented in Section 3.15.2, Groundwater Resources.

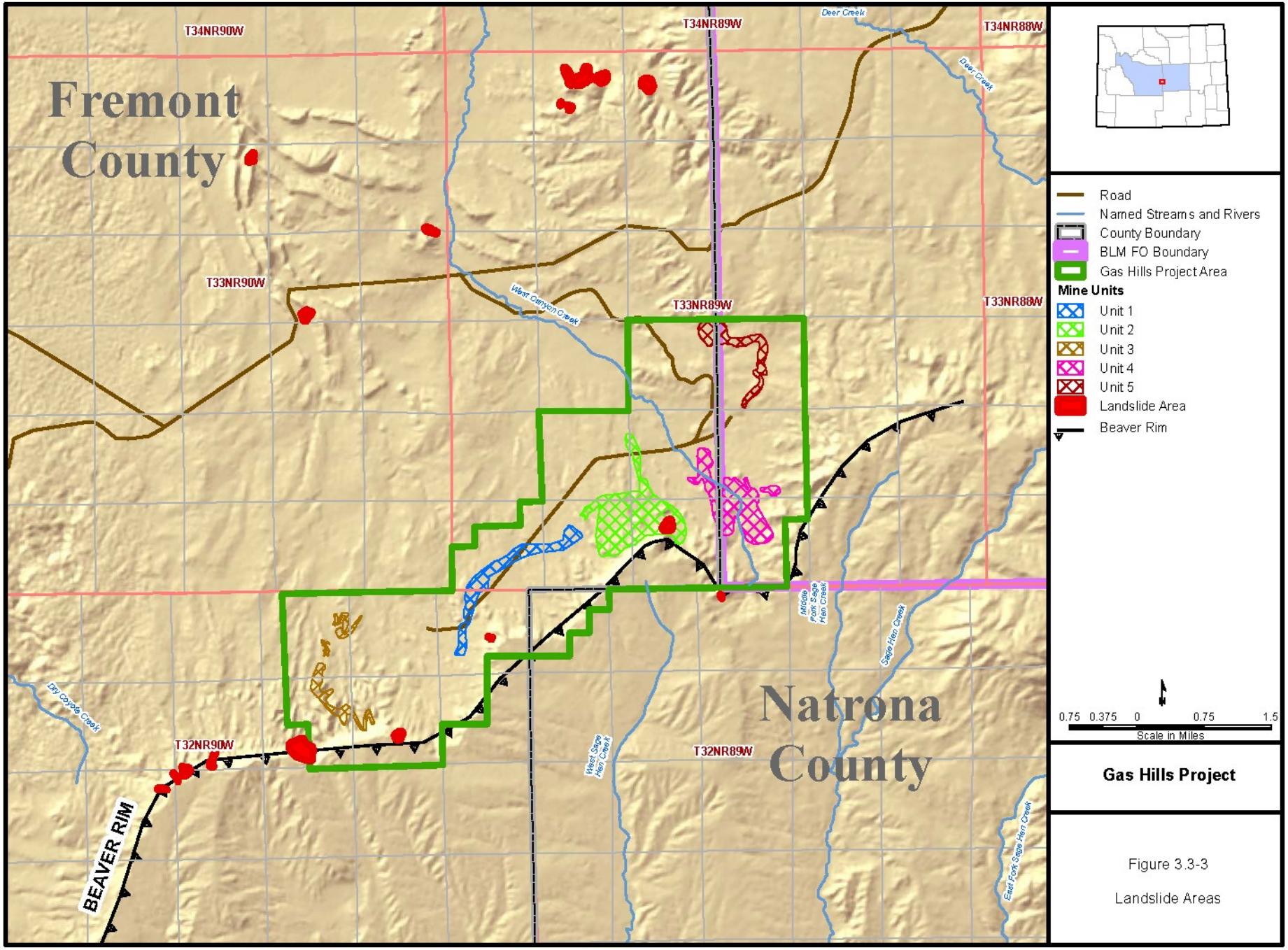


Figure 3.3-3

Landslide Areas

3.3.4.1 Uranium

Mining History, Gas Hills District

Uranium mining in the Gas Hills followed a cycle of boom and bust that began in 1954. By 1970, 4 mining companies dominated the Gas Hills District: Federal-American Partners, Union Carbide, Utah Mining Co., and Western Nuclear (Armstrong 1970). The AEC purchasing program ended in 1970, and by 1971 almost all of the produced uranium was being used for the nuclear power industry (Chenoweth 1991). The Gas Hills District produced about 100 million pounds of yellowcake concentrate (U_3O_8) through conventional mining methods (surface and underground), almost half of the total historical production of the state of Wyoming (PRI 2009; Uranium Producers of America 2011). In 1980, spot prices for yellowcake concentrate dropped from $40.00 per pound to $27.00 per pound. Mining activity declined in the 1980s as the mills and mines closed, and by the 1990s, several of the mine properties were undergoing reclamation. In addition, as discussed in Section 2.1.2.1, Historic Mining, tailings from milling activities associated with uranium mining in and adjacent to the GHPA have been capped and are being transferred to management by DOE under UMTRCA.

Geology and Mineralization of the Uranium Deposits

Mineralization in the Gas Hills area of the Wind River Basin consists of sedimentary uranium deposits in the Wind River Formation, with deposits in the GHPA being localized primarily in the Puddle Springs Member of the Wind River Formation (PRI 2009). Sedimentary uranium deposits were formed when oxidizing solutions carrying uranium moved through a sandstone aquifer and encountered a reducing environment, usually related to decaying organic material in the sandstone. The uranium is deposited at the oxidation/reduction interface. Sedimentary uranium deposits in the Wind River Formation in the Gas Hills area are “roll front” deposits in that they have a horseshoe or convex pattern in cross sectional view. These sedimentary uranium deposits often form irregular strings or lobes of ore following the sandstone aquifer in which they were formed.

The uranium ore in the Gas Hills is confined to the Wind River Formation which is composed of several members (Soister 1967) (**Table 3.3-2**). In the GHPA, the formation was deposited by north-flowing fluvial systems in a complex of depositional environments consisting of alluvial fans, stream channels, flood plains, lakes, and swamps (Seeland 1978). The lower fine-grained member of the Wind River Formation is composed of carbonaceous mudstone and shale with conglomerate beds near the base. The Puddle Springs member is comprised of arkosic sandstone and interbedded coarse-grained material derived from Precambrian granite. Some of these conglomerate beds were thick and persistent enough for Soister (1967) to identify them as the Dry Coyote Wash Conglomerate Bed and the Muskrat Conglomerate Bed (**Table 3.3-2**). The Upper Transition Zone consists of arkose and mudstone which is commonly bentonitic and tuffaceous.

Table 3.3-2 Stratigraphic Relationships of the Wind River Formation

System	Series	Stratigraphic Unit		
Tertiary	Eocene	Wagon Bed Fm.		
		Wind River Fm.	Upper Transition Zone	
			Puddle Springs Arkose Member	Muskrat Conglomerate Bed
				Dry Coyote Conglomerate Bed
			Lower Fine-grained Member	
Cretaceous	Upper	Cody Shale		

Note: Separation of geological layers (Systems or Series) that uncomfortably overlie each other are indicated by the dashed line in the table.

Source: Soister (1967).

The Gas Hills Uranium District contains 4 distinct alluvial fan systems within the Wind River Formation with uranium mineralization. In the GHPA, these 4 mineralized alluvial fans are labeled: the Deer Creek, Canyon Creek, Coyote Creek, and Muskrat systems from east to west across the GHPA (**Figure 3.3-4**). Approximately 90 percent of the nearly 100 million pounds of uranium mined historically in the Gas Hills District has come from sedimentary uranium deposits in the Coyote Creek system. Important historic mines include the Day Loma, Lucky Mc, Sunset, and Bullrush. The remaining 10 percent of historic production has come from the Deer Creek and Canyon Creek systems from mines such as the Buss, Tee, Veca, and Thunderbird. The average grade mined historically in the Gas Hills District was around 0.2 percent U_3O_8 (PRI 2009). The GHPA also includes a large segment of the Canyon Creek system and the eastern margin of the Coyote Creek system (**Figure 3.3-4**).

Mineralization in the GHPA consists of sedimentary uranium deposits hosted in channel sands and conglomerates of the Wind River Formation as roll front ore bodies, typically 15 feet in thickness and varying in width from 100 feet to less than a few feet. The high-grade ore is found within a few feet of the oxidation/reduction front with decreasing grades away from the oxidation/reduction interface.

Sandstones and conglomerates in the Puddle Springs Member often are separated by interbeds of clay or shale, and stacked ore zones can form in sandstone/conglomerate beds separated by interbeds of shale and clay. In plain view, the uranium ore bodies can often be traced for thousands of feet as sinuous zones of mineralization in the sandstone/conglomerate beds. Mineralization consists mainly of uraninite and coffinite with associated pyrite, arsenopyrite, and minor minerals formed from molybdenum, vanadium, and selenium (PRI 2009).

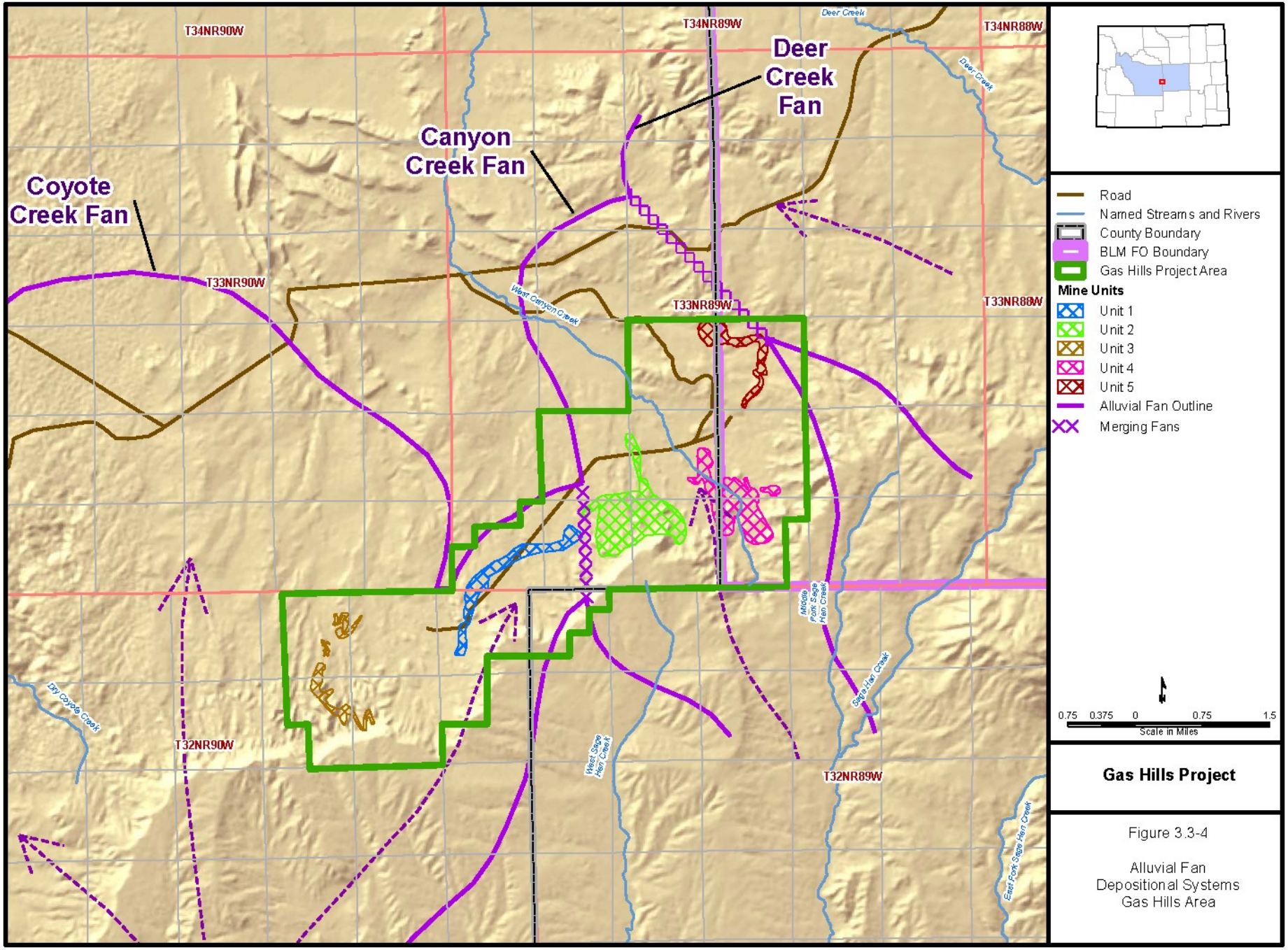
3.3.4.2 Oil and Gas

The first commercial oil field in Wyoming was Dallas Dome, discovered in 1884 and drilled in 1888. Dallas Dome is approximately 35 miles west of the GHPA in the southwest portion of the Wind River Basin. Since 1884, the basin has produced more than 0.5 billion barrels of oil and natural gas liquids, and over 5 trillion cubic feet of natural gas (Fox and Dolton 1995; Wyoming Oil and Gas Conservation Commission [WOGCC] 2011a).

The nearest oil field to the GHPA is the abandoned Travis Field, approximately 2 miles northwest of the GHPA with wells located primarily in Section 13, T33N, R90W (WOGCC 2011b). The field produced from the Phosphoria Formation with a reported production of 4,478 barrels from a depth of 797 to 812 feet (Wyoming Geological Association 1989; WOGCC 2011b). Another nearby field is Jones Draw, about 6 miles east of the GHPA on the east flank of the Rattlesnake Hills in T33N, R87W. The field had very small reported production from a lower Cretaceous zone and is now abandoned. Love (1970) reported oil-stained and oil-saturated beds in the Wagon Bed Formation in a surface uranium mine in Section 3, T32N, R94W, several miles west of the GHPA. It was surmised the oil originated in Paleozoic rocks and seeped into the Tertiary rocks where it was degraded by exposure.

Twenty exploratory oil and gas wells have been drilled within and in the sections surrounding the GHPA (**Table 3.3-3**). All the wells were plugged and abandoned presumably because commercially producible quantities of hydrocarbons were not found. The formations at total depths in these wells are indicative of the complexity of the buried pre-Tertiary structure and topography. For instance, the Nepple Government #1 well bottomed out in Precambrian rocks at a depth of 1,327 feet while the Tiger Oil Co. Government #1 encountered the Tensleep Formation below 4,000 feet depth (WOGCC 2011c). These wells are only 4 miles apart from each other.

There are currently no oil and gas leases within the GHPA. The nearest oil and gas lease to the GHPA is in Section 3, T33N, R90W, approximately 2.5 miles from the GHPA (WYW174775). This lease was issued in 2007 and expires in 2017.



Gas Hills Project

Figure 3.3-4

Alluvial Fan
Depositional Systems
Gas Hills Area

Table 3.3-3 Oil and Gas Test Wells[a] Drilled in the GHPA

API Number	Company	Well Name	Section, Township, Range	Qtr-Qtr	Total Depth (feet)	Formation at Total Depth
49-025- 05470	E Nepple	Govt 1	Section 7, T32N, R89W	NE SW	1327	Precambrian
49-013-20185	Mullinnix Assoc	Govt MA67-1	Section 2, T32N, R90W	NW NE	1042	Nugget
49-013-21482	Jade Oil Co	Federal 1-11	Section 11, T32N, R90W	SW NW	2460	Tensleep
49-013-05610	Amerada Hess	Strat 66	Section 16, T33N, R89W	SW SW	983	Tertiary
49-013-20105	Rl Girouard	Govt 1	Section 19, T33N, R89W	NW SE	1600	Red Peak
49-013-05585	Amerada Hess	Strat 81	Section 20, T33N, R89W	NW SE	719	Tertiary
49-013-05583	Amerada Hess	Strat 32	Section 21, T33N, R89W	NW SE	1690	Tertiary
49-013-05584	Amerada Hess	Strat 64	Section 21, T33N, R89W	NW SE	641	Tertiary
49-013-20675	Conpetro Inc	Federal 1-29	Section 29, T33N, R89W	SW SE	1802	Phosphoria
49-013-05572	Amerada Hess	Strat 32	Section 29, T33N, R89W	NW SW	875	Tertiary
49-013-05563	Vitro Minerals	Govt 1	Section 29, T33N, R89W	SW SW	503	Wind River
49-013-05771	Amerada Hess	Strat 23	Section 30, T33N, R89W	NW SW	465	Tertiary
49-013-20977	Arco	Canyon Ck 32-1	Section 32, T33N, R89W	NW NE	1780	Tensleep
49-013-21680	Barnhart Drlg	Federal 1-32	Section 32, T33N, R89W	SW SW	1700	Not reported
49-013-05558	Bm Burns	Federal-25 1	Section 25, T33N, R90W	SESW	1299	Chugwater
49-013-05544	Tiger Oil Co	Govt 1	Section 35, T33N, R90W	NE SE	4138	Tensleep
49-013-05555	Bm Burns	State-Roberts 1	Section 36, T33N, R90W	NE NW	1265	Phosphoria
49-013-20170	Stuarco Oil Co	Lowe-State 36-21	Section 36, T33N, R90W	NE NW	1455	Tensleep
49-013-20434	Dillard A R Jr	Mullinnix-Fraser 1	Section 36, T33N, R90W	NE NW	1265	Tensleep
49-013-05551	Bm Burns	State Roberts 2	Section 36, T33N, R90W	SE NW	2005	Tensleep

[a] All wells are exploratory wildcats plugged and abandoned, no production.

Source: WOGCC 2011c.

3.3.4.3 Gold

Gold anomalies were discovered in the Rattlesnake Hills in 1981 and 1982 as a result of research by the WSGS (Hausel 2009). Gold was found in a variety of geologic settings, including Precambrian vein and sulfide mineral deposits, as well as in Tertiary igneous rocks. The gold has been found in finely-disseminated low-grade to high-grade mineralization. Recent exploratory drilling has indicated the potential presence of gold deposits but no mining has been proposed.

3.3.4.4 Sand, Gravel, Stone

Sand is very abundant on the Granite Mountains area, but gravel deposits are not as common (Love 1970). Gravel deposits are present in pediments that slope down to the north from the Beaver Rim. The deposits are generally less than 15 feet thick and their location above flood plains led Soister (1967) to conclude that the gravel deposits are Pleistocene in age. Gravel also may occur locally in conglomerate beds in Tertiary rocks, as opposed to deposits associated with alluvium. No gravel pits are located within the GHPA (WDEQ-WQD 2011). However, there are several existing mineral material sales located near the GHPA that have been mined for limestone, sand, gravel, or shale for road construction and maintenance activities (**Figure 3.3-5**). The closest mineral materials sale contract to the GHPA is Pathfinder Mines limestone quarry (WYW151991) in Section 24, T33N, R90W. This quarry has undergone extensive mining and several large stockpiles occupy the site, but the permit has expired and additional mining is not anticipated.

Fremont County has two authorized free use permits (WYW168197 and WYW154885) along Fremont County Road 5 between Jeffrey City and the Gas Hills for sand and gravel. Natrona County has one authorized free use permit for stone and riprap material (WYW158101) northeast of the GHPA at the Rattlesnake Quarry. Umetco Minerals also has an authorized competitive sale contract (WYW139866) at the Rattlesnake Quarry. The WYDOT has a free use permit along Highway 136 for soil and fill material that is currently in pending status. Umetco Minerals has a pending noncompetitive sale contract (WYW142588) for limestone north of the GHPA in Section 14, T33N, R90W.

Limestone was mined in the late 1980s from the Alcova Limestone in the Dutton Anticline. About 500,000 cubic yards were mined for mining reclamation projects in the Gas Hills (BLM 2009a). Approximately 500,000 cubic yards of shale were mined in the Gas Hills area for mine reclamation projects.

3.3.4.5 Bentonite

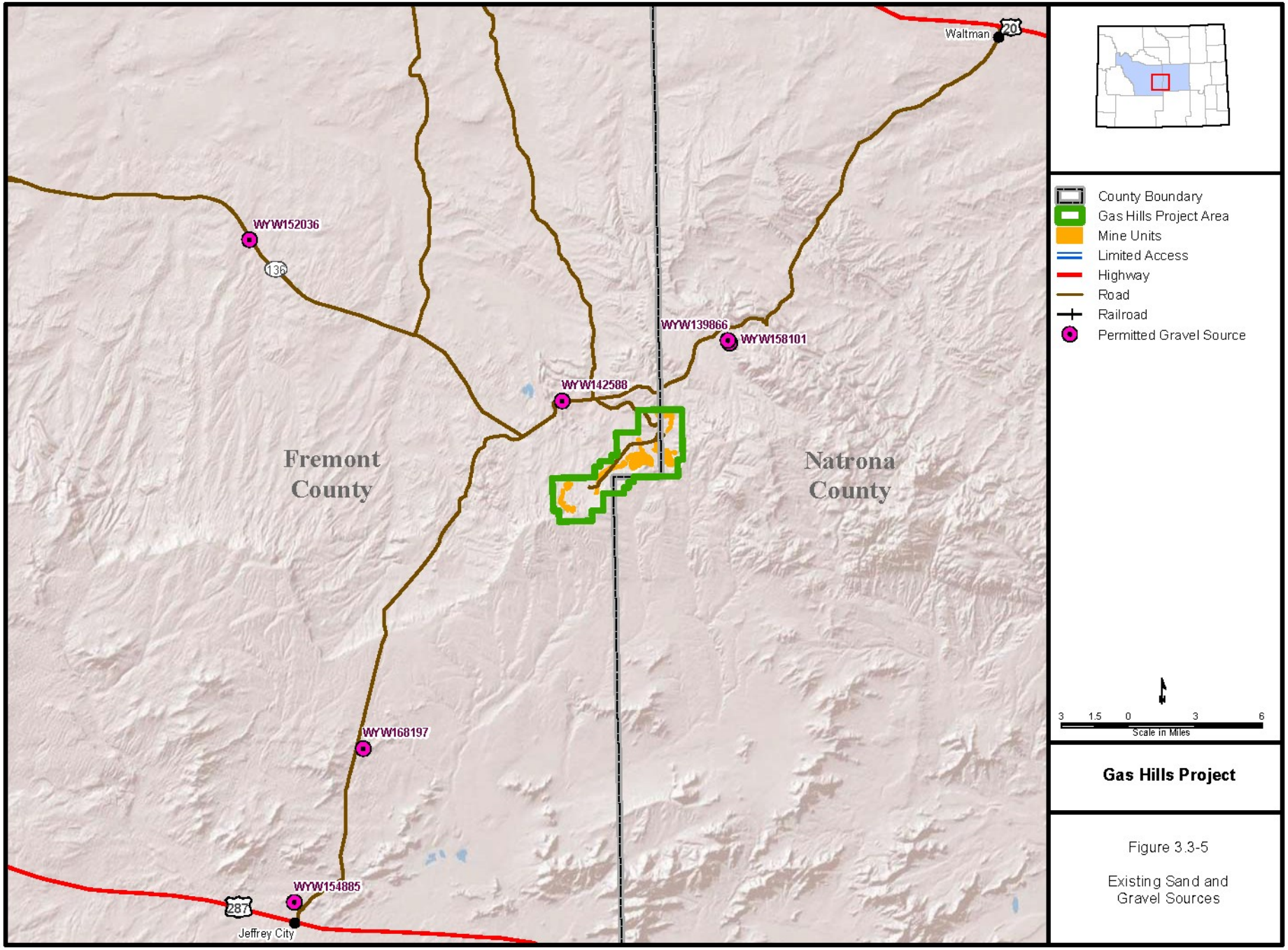
Bentonite and bentonitic mudstone may occur in beds in the Wind River, Wagon Beds, and White River formations (Van Houten 1964). A bentonite mine permitted under a company named Rock Springs Mineral Processing is located a few miles north of the GHPA in Sections 11 and 12, T33N, R90W (WDEQ-WQD 2011). The mining company has mined, and plans to continue mining, bentonite from Cretaceous rocks exposed in the Dutton Basin Anticline that forms the Gas Hills.

3.3.4.6 Coal

The Fort Union Formation, the most likely geologic unit to contain potentially mineable coal resources, is not present in the GHPA (Soister 1967). The Wind River Formation does contain coal, but the beds are thin making them uneconomic (less than 1 foot thick) and were not considered in the most recent USGS coal resource assessment of the Wind River Basin (BLM 2009a; Flores and Keighin 1999)

3.3.4.7 Jade

Jade has been identified in boulders that have eroded from Precambrian rocks of the Granite Mountains and are contained within the Wind River Formation. A jade locality identified by Love (1970) is located about 10 miles southwest of the GHPA.



Gas Hills Project

Figure 3.3-5

Existing Sand and Gravel Sources

3.3.4.8 Other Minerals

Small deposits of zeolite and pumice are found in the Gas Hills area (Hausel et al. 1979), but extent and localities are unknown.

3.4 Land Use

3.4.1 Land Use/Land Cover

Land uses in the GHPA include mining, livestock grazing, and recreation. A large portion of the GHPA is covered by a sagebrush grassland cover type that is conducive to grazing. Livestock grazing and land cover are further discussed in Section 3.5, Livestock Grazing; and Section 3.13, Vegetation. Existing disturbance within the GHPA is approximately 1,300 acres. Of these 1,300 acres, 69 percent, or 890 acres, have been reclaimed and vegetation reestablished. Recreational activities include hunting, hiking, and OHV use. The nearest designated utility corridors are approximately 4 miles to the west and north. There are no communication sites or land withdrawals within the GHPA. The nearest communication site and land withdrawal are approximately 10 miles to the north. Within the northern border of the GHPA is a portion of a historic uranium mining operation, which includes a cap over historic uranium tailings. Management of this cap is currently being transferred to the DOE. Once the transfer is complete a LTSP would be implemented to protect public health, safety, and the environment. This area is shown in **Figure 3.4-1**.

3.4.2 Land Ownership

As shown in **Figure 3.4-1** and summarized in **Table 3.4.1**, the BLM manages most of the surface and minerals within the GHPA, with some state and private lands also present. Instances where surface ownership and the underlying mineral ownership are not owned by the same entity are known as split estate. Less than 1 percent (61 acres) of the lands within the GHPA are split estate, where the BLM does not manage the surface, but does manage the underlying minerals. Private lands and Wyoming State lands make up approximately 6 percent of the remainder of the surface land ownership and mineral estate in the GHPA. The Wyoming Office of State Lands and Investments manages state trust lands. Revenues generated by trust lands and minerals are reserved for the exclusive benefit of public schools and certain other designated public institutions in Wyoming such as the Wyoming State Hospital (Wyoming Office of State Lands and Investments 2011).

Table 3.4-1 Land Management or Ownership in the GHPA

Management or Ownership	Surface		Mineral	
	Percent	Acres	Percent	Acres
Federal	94	7,977	94	8,038
State	2	164	6	480
Private	4	377		
Total	**100**	**8,518**	**100**	**8,518**

Note: Data showing separated state and private ownership was not available.

3.4.3 Land Use Management

3.4.3.1 Special Management Area

As defined in the Lander Draft EIS (BLM 2011b), a Special Recreation Management Area is an area where congressionally recognized recreation values exist or where significant public issues or management concerns occur. There are no SRMAs contained either wholly or partially within the GHPA.

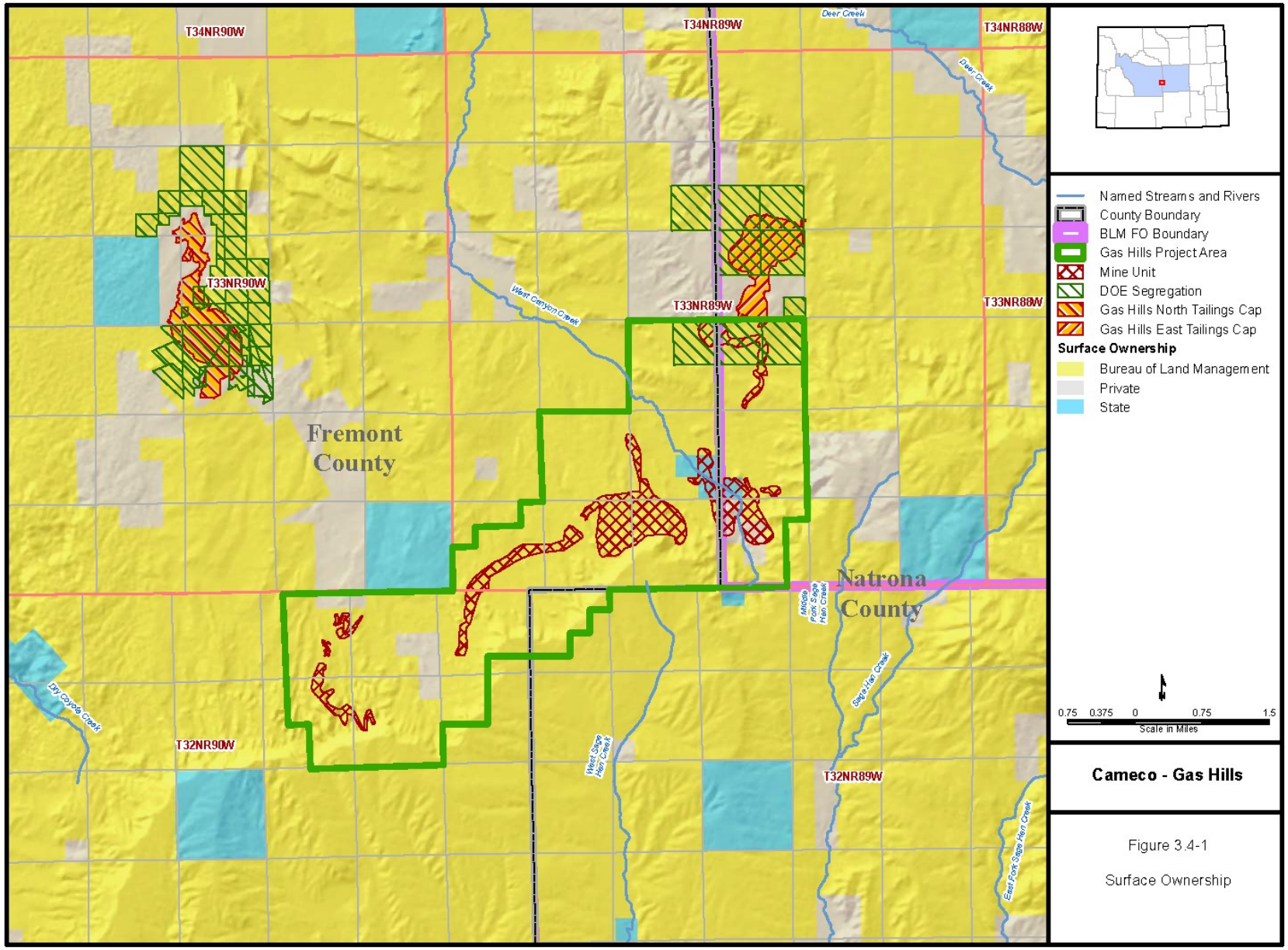


Figure 3.4-1

Surface Ownership

The GHPA does fall within a designated development area (DDA) as defined within the Lander Draft RMP (BLM 2011b). DDAs are established for intensive mineral exploration, development, and production, and often use different management and reclamation standards than areas outside a DDA.

3.4.3.2 Areas of Special Designation

No areas of special designation are located either wholly or partially within the GHPA. Areas of special designation that are closest to the GHPA include: Wind River Management Area (10 miles to the northeast); Oregon/Mormon Pioneer National Historic Trail (18 miles to the south); the Bridger National Historic Trail (20 miles to the northeast); Pathfinder National Wildlife Refuge (25 miles to the southeast); and the Wind River Indian Reservation (29 miles to the northwest). There are no ACECs within or near the GHPA. The nearest ACEC is the National Historic Trails ACEC, over 18 miles to the southwest. Wilderness study areas (WSAs) closest to the GHPA include Lankin Dome, Split Rock, Miller Springs, and Savage Peak WSA. The nearest WSA, Lankin Dome, is approximately 14 miles to the south.

3.5 Livestock Grazing

The study area for livestock grazing is defined as the GHPA. The following section presents range management activities per allotment and water-related range improvements within the study area. Implementation of the Project would result in the expansion of existing operations, thus disturbing areas currently being grazed.

Land ownership within the study area is predominately federal with scattered patches of state and private land. Four BLM grazing allotments are located in the GHPA. Cattle are permitted on all 4 allotments, and sheep also are permitted on the Gas Hill Allotments which graze from early spring to early winter. The majority of the GHPA is within the Gas Hills Allotment. Smaller portions of the Blackjack Ranch and Diamond Springs allotments are located on top of the Beaver Rim, in the GHPA, but outside of the areas that would be impacted by Project disturbance. A small portion of the Matador Allotment is located along the eastern-most portion of the GHPA. The Blackjack Ranch and Matador allotments are grazed summer to fall, and fall to winter, respectively. The vegetation in the area is predominantly grassland and sagebrush steppe. For a more detailed description of the vegetation found in the GHPA see Section 3.13, Vegetation.

Table 3.5-1 provides a summary of each BLM grazing allotment within the study area, including acreage calculations, current stocking rates, and permitted use in animal unit months (AUMs). **Figure 3.5-1** illustrates the BLM grazing allotments within the study area.

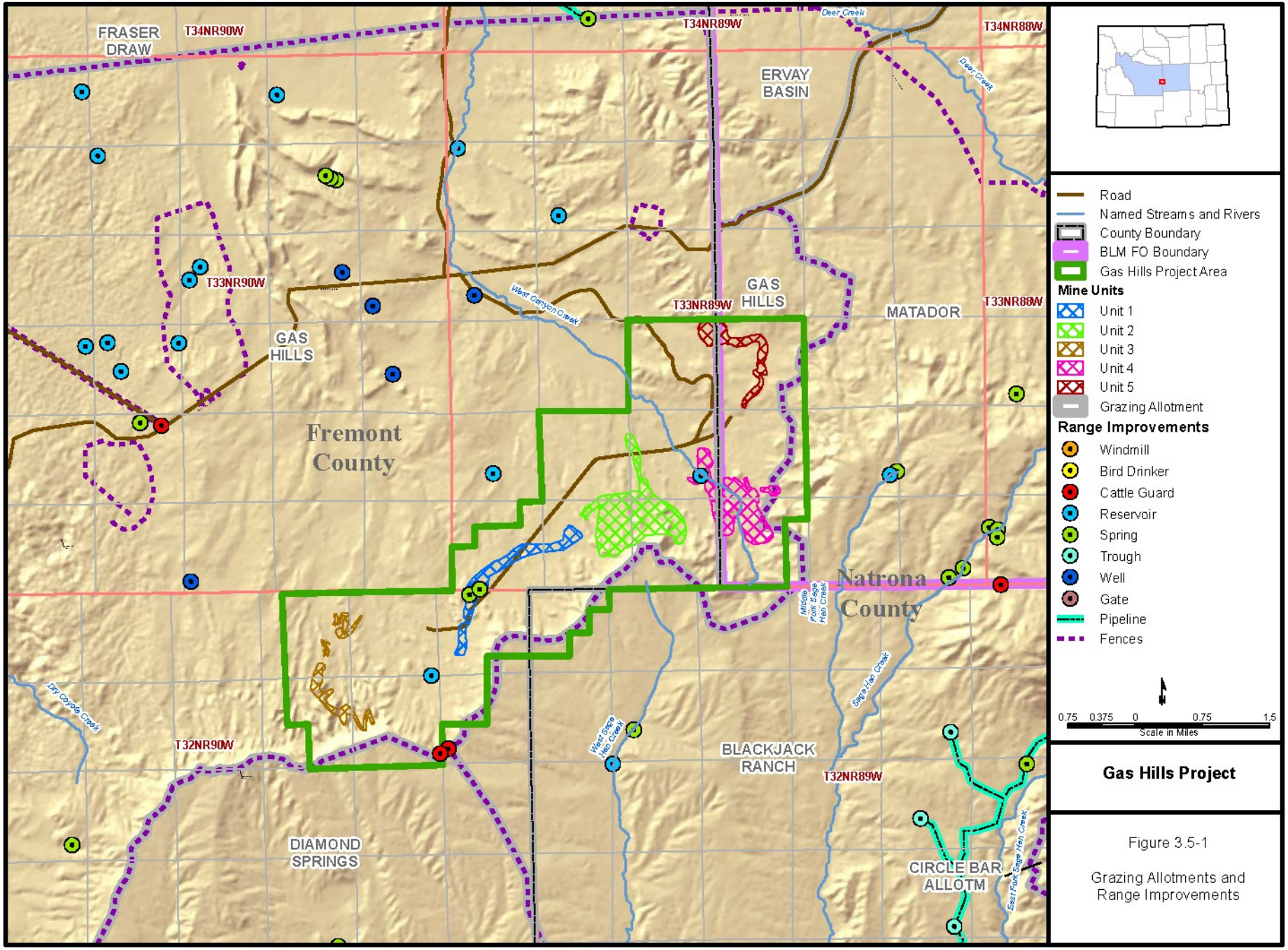
Table 3.5-1 Grazing Allotments in the Study Area

Grazing Allotment Name	Total Allotment AUMs[a]	Allotment Acreage within the Project	Projected AUMs within Project [b]	Livestock		Season of Use	Percent of Public Land
				Type	Number		
Blackjack Ranch	3,608	328	32	Cattle	1,200	10/5-10/29; 6/5-7/16	69
Diamond Springs	4,956	180	21	Cattle	1,200	5/31-6/4; 10/30-11/2; 8/22-10/04; 7/17-8/21	56; 56; 92;92
Gas Hills	3,547	7,719	363	Cattle/ Sheep	328/1200	5/16 - 12/10; 5/16 - 12/10	83
Matador	2,096	291	18	Cattle	468	9/30-12/30	76

[a] An AUM represents the quantity of forage necessary to sustain 1 cow-calf pair or 5 sheep for 1 month.

[b] Projected active AUMs were calculated based on the percentage of the allotment within the GNBPA compared to the allotment as a whole.

The BLM has developed the BLM Wyoming Rangeland Health Standards to achieve desired conditions for BLM managed lands. The Wyoming BLM Rangeland Health Standards include the Fundamentals of Rangeland Health and its companion rules, the Standards for Rangeland Health and Guidelines for Grazing Management for BLM in Wyoming. The standards describe specific conditions needed for healthy public lands. The guidelines are the techniques used to achieve or maintain these standards (BLM 2011c). Management and resource use of BLM-managed lands in Wyoming must apply the BLM Wyoming Rangeland Health Standards. The Fundamentals of Rangeland Health outline the conditions that must exist on BLM lands. These include:



Gas Hills Project

Figure 3.5-1

Grazing Allotments and Range Improvements

1. Properly functioning watersheds;
2. Water, nutrients, and energy are cycling properly;
3. Water quality complies with state water quality standards; and
4. Threatened and endangered species habitat is being protected.

The standards address the acceptable conditions for public rangelands based on the health, productivity, and sustainability of the rangelands.

A Rangeland Standards Conformance Review was conducted for the Gas Hills in 1998 (BLM 1998a). The Gas Hills Allotment met all 6 standards; however, previously disturbed mine sites were identified as not being in conformance with the standards. Livestock grazing was not a contributing factor for the failures discussed in the assessment. The status of reclamation and the amount of established vegetation in these areas affected how the resource conditions met the standards. These sites are monitored by the WDEQ Abandoned Mine Land Division and LQD, the BLM, and responsible mining companies under authority of the Surface Mining Control and Reclamation Act of 1977 and the Wyoming Environmental Quality Act of 1969. Previous inventories and studies have indicated that approximately a quarter of the Gas Hills Allotment, located in the northern portion of the allotment, historically has been heavily grazed by both livestock and wildlife and could be improved. Livestock grazing would continue to be managed as prescribed in the Grazing Supplement to the Final RMP/EIS for the Lander Resource Area (BLM 1998a).

Water sources for livestock include intermittent and ephemeral streams, reservoirs, springs, and stock ponds. Range improvements in the GHPA include cattleguards and reservoirs. Range improvements by grazing allotment are listed in **Table 3.5-2** and are shown in **Figure 3.5-1**. Fencing associated with hazards from historic mining activities or historic reclamation exists in the GHPA. The locations of this fencing have not been mapped and are not shown in **Table 3.5-2** or **Figure 3.5-1**.

Table 3.5-2 Range Improvements

Grazing Allotment Name	Range Improvement Type	Range Improvement Name
Diamond Springs	Cattleguard	N/A
Gas Hills	Reservoir	Cameron Spring Reservoir

3.6 Noise

Sound intensity is measured by the decibel (dB). Audible sounds range from 0 dB (threshold of hearing) to about 140 dB (threshold of pain), and the normal audible frequency range is approximately 20 Hertz to 20 kilohertz. The A-weighted scale, denoted as dB(A), is used in most noise ordinances and standards, and approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as higher frequency noises. Rustling leaves have a decibel level of 10 dB(A); conversational speech is 60 dB(A); and aircraft takeoff is 120 dB(A).

Ambient, or background, noise is defined as an assortment of sounds from nearby and distant sources, relatively steady and homogeneous, with no particular identifiable source (National Wind Coordinating Committee 2002). Rural ambient noise typically ranges from 20 dB(A) to 40 dB(A) (British Wind Energy Association 2000). The Project is characterized by rural background noise typically consisting of natural noise sources, such as wind and wildlife, as well as manmade noise sources typically associated with ranching, such as noise from cattle and ranch vehicles. Existing noise sources also include traffic along State Highway 136 and Dry Creek Road near the GHPA.

No noise studies have been conducted within the GHPA. With the exception of noise from truck traffic, operations equipment at ISR uranium recovery facilities, such as pumps and compressors, are typically housed within structures, limiting the transmission of noise. There are no schools, hospitals, recreation areas, or residential areas located within or adjacent to the GHPA. There are no known residences within a 2 mile buffer around the GHPA. The nearest town is Jeffrey City, approximately 22 miles to the southwest, with a population of 64 (U.S. Census Bureau 2010).

3.7 Paleontological Resources

3.7.1 Regulatory Framework

3.7.1.1 Federal Regulations and Guidance

Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (P.L. 59-209; 16 USC 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federally administered lands. Federal protection for scientifically important paleontological resources would apply to construction or other related project impacts that would occur on federally owned or managed lands. This act provides for funding for mitigation of paleontological resources discovered during federal aid highway projects, provided that "excavated objects and information are to be used for public purposes without private gain to any individual or organization." In addition to the foregoing, the National Registry of Natural Landmarks provides protection to paleontological resources. The BLM manages paleontological resources (fossils) on federal lands under the following statutes and regulations (BLM 2012a):

- FLPMA (P.L. 94-579);
- NEPA (P.L. 91-190);
- Title 43 CFR, which addresses the collection of invertebrate, vertebrate, and plant fossils; and
- The Paleontological Resources Preservation Act of 2009 (PRPA) (P.L. 111-011). The law authorizes the BLM and USFS to manage and provide protection to fossil resources using "scientific principles and expertise". The act defines paleontological resources as "any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth".

The PRPA also empowers the USDOI to implement the following provisions:

- Develop appropriate plans for inventory, monitoring, and the scientific and educational use of paleontological resources, in accordance with applicable agency laws, regulations, and policies. These plans shall emphasize interagency coordination and collaborative efforts where possible with non-federal partners, the scientific community, and the general public.
- Develop programs to increase the public's awareness about the significance of paleontological resources shall be established.

In addition to the statutes and regulations listed above, fossils on public lands are managed through the use of internal BLM guidance and manuals. BLM Manual 8270 (BLM 1998b) and the BLM Handbook H-8270-1 (BLM 1998c) contain the BLM's policy and guidance for the management of paleontological resources on public land and information. The manual presents information on the authorities and regulations related to paleontological resources. The handbook gives procedures for permit issuance, requirements for qualified applicants, and information on paleontology and planning.

Important guidance in the protection of paleontological resources is contained in Instruction Memorandum (IM) 2009-011 which provides guidelines for the assessment of potential impacts, field survey procedures, determination of mitigation requirements (if needed), monitoring procedures, documentation of findings, and curation of specimens (BLM 2008a).

3.7.1.2 Potential Fossil Yield Classification System

With issuance of IM 2008-009, the BLM adopted the Potential Fossil Yield Classification (PFYC) system to identify and classify fossil resources on federal lands (BLM 2007). Paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability

for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

The PFYC system is a way of classifying geologic units based on the relative abundance of vertebrate fossils or scientifically significant fossils (plants, vertebrates, and invertebrates) and their sensitivity to adverse impacts. A higher class number indicates higher potential. The PFYC is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment. The PFYC system is meant to provide baseline guidance for predicting, assessing, and mitigating paleontological resources. The classification should be considered at an intermediate point in the analysis and should be used to assist in determining the need for further mitigation assessment or actions. The BLM intends for the PFYC system to be used as a guideline as opposed to rigorous definitions. Descriptions of the potential fossil yield classes are summarized in **Table 3.7-1**. The entire IM 2008-009, with a description of the PFYC system, is provided in **Appendix B**.

Table 3.7-1 Potential Fossil Yield Classification System

Class	Description	Basis	Comments
1	Igneous and metamorphic (tuffs are excluded from this category) geologic units or units representing heavily disturbed preservation environments that are not likely to contain recognizable fossil remains.	Fossils of any kind known not to occur except in the rarest of circumstances. Igneous or metamorphic origin. Landslides and glacial deposits.	The land manager's concern for paleontological resources on Class 1 acres is negligible. Ground disturbing activities will not require mitigation except in rare circumstances.
2	Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant invertebrate fossils.	Vertebrate fossils known to occur very rarely or not at all. Age greater than Devonian. Age younger than 10,000 years B.P. Deep marine origin. Aeolian origin. Diagenetic alteration.	The land manager's concern for paleontological resources on Class 2 acres is low. Ground disturbing activities are not likely to require mitigation.
3	Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Also sedimentary units of unknown fossil potential.	Units with sporadic known occurrences of vertebrate fossils. Vertebrate fossils and significant invertebrate fossils known to occur inconsistently; predictability known to be low. Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.	The land manager's concern for paleontological resources on Class 3 acres may extend across the entire range of management. Ground disturbing activities will require sufficient mitigation to determine whether significant paleontological resources occur in the area of a proposed action. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.

Table 3.7-1 Potential Fossil Yield Classification System

Class	Description	Basis	Comments
4	Class 4 geologic units are Class 5 units (see below) that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation.	Significant soil/vegetative cover; outcrop is not likely to be impacted. Areas of any exposed outcrop are smaller than 2 contiguous acres. Outcrop forms cliffs of sufficient height and slope that most exposed surfaces are out of reach by normal means. Other characteristics that lower the vulnerability of both known and unidentified fossil localities.	The land manager's concern for paleontological resources on Class 4 areas is toward management and away from unregulated access. Proposed ground disturbing activities will require assessment to determine whether significant paleontological resources occur in the area of a proposed action and whether the action will impact the paleontological resources. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.
5	Highly fossiliferous geologic units that regularly and predictably produce invertebrate fossils and/or scientifically significant invertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts.	Vertebrate fossils and/or scientifically significant invertebrate fossils are known and documented to occur consistently, predictably, and/or abundantly. Unit is exposed; little or no soil/vegetative cover. Outcrop areas are extensive; discontinuous areas are larger than 2 contiguous acres. Outcrop erodes readily; may form badlands. Easy access to extensive outcrop in remote areas. Other characteristics that increase the sensitivity of both known and unidentified fossil localities.	The land manager's highest concern for paleontological resources should focus on Class 5 areas. Mitigation of ground disturbing activities is required and may be intense. Areas of special interest and concern should be designated and intensely managed.

Source: BLM 2008b, 2007.

Rock units with a PFYC of 3 are the most problematic from a management perspective and require some decision and action because in Class 3 units fossil content varies in important abundance, and predictable occurrence or the units have unknown fossil potential. For Class 3 units the concern is moderate or cannot be determined from existing data. Class 3 units include a broad range of paleontological potential including unknown potential to moderate or infrequent occurrence of important fossils. Management consideration covers a broad range of options and could include pre-disturbance surveys, monitoring, or avoidance. Proposed surface-disturbing activities on Class 3 rock units require sufficient assessment to determine whether important paleontological resources occur in the area of a proposed action and whether that action could affect the paleontological resources.

3.7.2 Fossil Resources in the Gas Hills Project Area

Only formations that may potentially be disturbed by the proposed mining activities in the GHPA are considered in this discussion. Those formations are geologic units listed in **Table 3.7-2**.

Table 3.7-2 Geologic Formations with Potential for Fossils

Formation-Deposit	PFYC Rating	Fossil Types
Alluvium, terrace, wind-blown deposits	1 to 2	Not determined.
Split Rock Formation	3	Vertebrates, invertebrates, and plants.
White River Formation	5	Vertebrates, invertebrates, and plants.
Wagon Bed Formation	5	Vertebrates, invertebrates, and plants.
Wind River Formation	4 to 5	Vertebrates, invertebrates, and plants.

Source: BLM 2008.

The Wind River, Wagon Bed, White River, and Split Rock formations have the potential for “outstanding” paleontological resources of high scientific value (BLM 2009b). The Wind River Formation includes localities that have yielded fossils of some of the earliest mammals. Of special interest are the remains of an extinct mammal called a Titanothere that was probably related to modern horses, found in locations close to the GHPA (Van Houten 1964). Titanothere jaw fragments also have been found in the Wagon Bed and White River formations.

A paleontological survey of the GHPA (ARCADIS 2011) was conducted in July and August 2011 in order to assess fossil resources. Four historic fossil localities are located within the GHPA boundary and provided a variety of vertebrate fossils from the White River Formation and Wind River Formation. Twenty-five new localities were found within the GHPA; at one locality a high-value specimen was discovered. All of the new localities are in the White River Formation and demonstrate the potential for scientifically important fossils in the GHPA.

3.8 Public Health and Safety

Public health and safety includes the transportation and use of hazardous materials, generation of solid waste, and potential exposure of the public and workers to radioactivity. The following section provides a discussion of the regulatory framework of how various hazardous materials and solid wastes are defined under numerous programs. It also describes the kinds of radioactive materials that would be generated through ore processing and radioactive background that could be encountered on-site from past mining activities.

3.8.1 Exposure to Radioactive Materials

Radioactive exposure is measured by a quantity called the roentgen and is a measurement of the ionizations of molecules in a given mass of air by gamma rays or x-rays (University of Idaho 2011). A unit called the roentgen equivalent man (rem) is used to relate the radiation exposure to potential live tissue damage since different kinds of radioactivity can cause different effects even for the same amount of absorbed radiation. The rem is often expressed in terms of millirem (mrem).

3.8.1.1 Background Radiological Materials

The annual natural background radiation exposure to U.S. residents varies by location and elevation, but is about 360 mrem per year (mrem/yr) (Idaho State University 2011). The average U.S. resident also receives additional radiation exposure from manmade sources such as medical tests and consumer products. **Table 3.8-1** compares various radiation exposures from activities or exposure thresholds.

Table 3.8-1 Comparative Doses of Radioactivity

Activity or Event	Dose
Annual background radiation in the U.S.	360 mrem
Flying 3,000 miles	3 mrem
Chest x-ray	10 mrem
CT scan	500 mrem-1,000 mrem
Annual whole body limit for workers	5,000 mrem
Annual thyroid limit for workers	50,000 mrem
Radiation sickness (Acute Radiation Syndrome)	100,000 mrem whole body
Erythemia (skin reddening)	500,000 mrem to skin

Source: Idaho State University 2011.

Background doses of radiation typically are a function of elevation change. An increase in elevation correlates to an increase in the exposure to cosmic radiation. The average cosmic radiation in the GHPA is expected to be greater than the national average due to its higher elevation. The presence of radon, a radioactive gas naturally found in soil, is dependent on the type, porosity, and moisture content in the soil and/or bedrock. The average natural and manmade radiation dose for the state of Wyoming is 316 (mrem/yr), lower than the U.S. average. This is attributable to a lower Wyoming average radon dose, 133 (mrem/yr), than the U.S. average of 200 (mrem/yr) (USEPA 2005).

In order to determine the health and safety risk to the public, as well as to Project workers, a radiological survey and soil sampling program was conducted to establish the background radiological environment over the GHPA (U.S. NRC 2004). The gamma exposure rates of the project site averaged approximately 175 mrem/yr. This is slightly more than half the equivalent annual dose the average individual in the U.S.

receives from all sources of natural radiation, including contributions from naturally occurring radioactive material in the soil. A pre-operational air modeling program at 4 locations across the Gas Hills area produced similar results.

Within the northern border of the GHPA is a portion of an historic uranium mining operation currently owned by Umetco, which includes a cap over historic uranium tailings (Gas Hills East). This cap includes a radon barrier, filter layer, frost-protection layer, and a riprap cover. This area is shown in **Figure 2-1**. The purpose of this cap is to reduce the radon gas emission rate to below the regulatory standard (20 picocuries [pCi] per square meter per second), as well as physically contain contaminated materials. This area has been withdrawn from public access and is surrounded by warning signs and a barbwire fence. Management of this cap is currently being transferred to the DOE. Once the transfer is complete a LTSP would be implemented to protect public health, safety, and the environment. This area is shown in **Figure 3.4-1**. Although there is no current activity at the GHPA, occupational health and safety risks to workers would include exposure to radioactive materials. Radiation safety practices for workers at uranium ISR facilities should be such that the dose to the workers is kept as low as is reasonably achievable. Radiation exposure limits are specified in 10 CFR Part 20. Both the Occupational Safety and Health Administration (OSHA) and the U.S. NRC, through an MOU, have jurisdiction over occupational safety and health at U.S. NRC-licensed facilities (OSHA 1988).

Long-term monitoring of the capped area, once management is assumed by the DOE, will consist of the following measures (DOE 2010):

- Annual site inspection;
- Follow-up inspections and inspection reports, as necessary;
- Site maintenance, as necessary;
- Emergency measures in the event of catastrophe; and
- Environmental monitoring to include groundwater, vegetation, and land use.

In addition to monitoring, there are site control features to restrict access including fencing, boundary monuments, a site marker, and warning signs. These control features are to be inspected and maintained as needed.

Throughout the Gas Hills region, naturally occurring uranium results in the formation of radon-222, a radioactive gas. Radon gas is formed through the radioactive decay of uranium. Uranium and radon are ubiquitous in the U.S. although concentrations vary regionally and depend on the amount of uranium present in the soil, rocks, and water (http://www.epa.gov/radon/zonemap.html). Exposure to elevated levels of radon gas can increase cancer risk. The USEPA indicates that radon gas is responsible for 21,000 deaths in the U.S. per year (http://www.epa.gov/radon/pubs/citguide.html). Because of the health risk posed by radon gas, the USEPA air quality standard is 4 pCi per liter. Since radon is heavier than air, radon concentrations tend to be most common in confined spaces with limited air flow, such as residential basements during winter months. Regardless of the setting, whether it is residential or industrial, radon gas emissions typically are mitigated by external venting.

3.8.2 Hazardous Materials and Solid Waste

3.8.2.1 Waste Definitions

For purposes of this analysis, 2 major types of waste are considered; solid waste and nuclear waste. These types of waste are described below.

<u>Solid Waste</u>

Solid waste consists of a broad range of materials that include garbage, refuse, waste water treatment plant sludge, non-hazardous industrial waste, and other materials (solid, liquid, or contained gaseous

substances) resulting from industrial, commercial, mining, agricultural, and community activities (USEPA 2005). Solid wastes are regulated under different subtitles of Resource Conservation and Recovery Act (RCRA) and include hazardous waste (discussed in the previous section) and non-hazardous waste. Non-hazardous wastes are regulated under RCRA Subtitle D. Under RCRA, the USEPA regulates certain radioactive wastes.

Hazardous Materials (Non-Radioactive)

"Hazardous materials," which are defined in various ways under a number of regulatory programs, can represent potential risks to both human health and the environment when not properly managed. The term hazardous materials include the following materials that may be utilized or disposed of in construction and operation:

- Substances covered under OSHA Hazard Communication Standards (29 CFR 1910.1200 and 30 CFR 42): The standard covers many chemicals and substances commonly used at industrial worksites.
- “Hazardous materials" as defined under DOT regulations at 49 CFR, Parts 170-177: The types of materials that may be used in construction and operational activities and that would be subject to these regulations would include, cement, fuels, some paints and coatings, and other chemical products.
- “Hazardous substances” as defined by Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and listed in 40 CFR Table 302.4: The types of materials that may contain hazardous substances that would be subject to these requirements would include solvent-containing materials (e.g., paints, coatings, degreasers), acids, and other chemical products.
- “Hazardous wastes” as defined in the RCRA: Procedures in 40 CFR 262 are used to determine whether a waste is a hazardous waste. Hazardous wastes are regulated under Subtitle C of RCRA.
- Any “hazardous substances” and "extremely hazardous substances" as well as petroleum products such as gasoline, diesel, or propane, that are subject to reporting requirements if volumes on-hand exceed threshold planning quantities under Sections 311 and 312 of Superfund Amendment and Reauthorization Act (SARA): The types of materials that may be used in construction and operational activities and that could be subject to these requirements would include fuels, coolants, acids, and solvent-containing products such as paints and coatings.
- Petroleum products defined as "oil" in the Oil Pollution Act of 1990: The types of materials that would be subject to these requirements include fuels, lubricants, hydraulic oil, and transmission fluids.

In conjunction with the definitions noted above, the following lists provide information regarding management requirements during transportation, storage, and use of particular hazardous chemicals, substances, or materials:

- The SARA Title III List of Lists or the Consolidated List of Chemicals Subject to Emergency Planning and Community Right-to-Know Act and Section 112(r) of the CAA.
- The USDOT listing of hazardous materials in 49 CFR 172.101.

Certain types of materials, while they may contain potentially hazardous constituents, are specifically exempt from regulation as hazardous wastes. Used oil, for example, may contain toxic metals, but would not be considered a hazardous waste unless it meets certain criteria. Other wastes that might otherwise be classified as hazardous are managed as “universal wastes” and are exempted from hazardous waste regulation as long as those materials are handled in ways specifically defined by regulation. An example

of a material that could be managed as a universal waste is lead-acid batteries. As long as lead-acid batteries are recycled appropriately, requirements for hazardous waste do not apply.

Radioactive Waste

How radioactive waste is defined is complex because of the diverse nature of how the waste is generated. Of particular concern for the Project is what is termed low-level radioactive waste (USEPA 2011a). While not necessarily being of low radioactive content, low-level radioactive waste does not include:

- Spent nuclear fuel;
- High-level waste;
- Transuranic waste; and
- Uranium and thorium mill tailings.

The U.S. NRC and states under agreement with U.S. NRC regulate commercial disposal of low-level radioactive waste in near-surface disposal facilities. The DOE regulates disposal at its own sites.

Other defined radioactive wastes include low-activity radioactive waste that contains very small concentrations of radionuclides. The concentrations are small enough that managing these wastes may not require all of the radiation protection measures necessary to manage higher-activity radioactive material to be fully protective of public health and the environment. Low level or low activity radioactive wastes may be mixed with RCRA-defined waste and are regulated under the RCRA.

The U.S. NRC has the major regulatory authority over the proposed mining operations. The U.S. NRC licenses facilities that handle or use radioactive materials including nuclear power reactors, non-power research, test and training reactors, fuel cycle facilities, medical, academic, and industrial uses of nuclear materials; and the transport, storage, and disposal of nuclear materials and waste. The U.S. NRC also is responsible for developing, implementing, and enforcing U.S. NRC licensing criteria, USEPA standards and regulations, and other federal regulations at these facilities (USEPA 2000).

Federal regulation of radioactive materials has evolved over the years. Originally the AEC was charged with the responsibility for the regulation of nuclear materials (USEPA 2000). When the USEPA was created in 1970, certain limited regulatory authority was transferred from the AEC, now the U.S. NRC, and other regulatory entities to the USEPA.

Since the USEPA was created, Congress has enacted statutes delegating authority to the USEPA to regulate hazardous materials in specific environmental media. These statutes (including the CAA; the Safe Drinking Water Act; and the CERCLA, expanded the scope of the agency's radiological protection authority.

3.9 Recreation

The area in and around the GHPA typically is used for hunting, hiking, and OHV use. There are no developed recreation areas within or adjacent to the GHPA (**Figure 3.9-1**). Designated recreation areas closest to the GHPA include: Agate Flats (6 miles to the south); Castle Gardens Rock Art Site (7 miles to the north); and the Heritage Tourism and Recreation Area (12.5 miles to the south). The Oregon and Bridger National Historic trails are each nearly 20 miles to the south and northeast from the GHPA, respectively. Data for the number of hikers, hunters, and other recreational users in the study area is difficult to collect due to the dispersed nature of recreational activities. Therefore, it is not available for this analysis. Within the GHPA, all of the BLM-managed land is designated as being limited to existing roads and vehicle routes.

Portions of the Muskrat Mule Deer Hunt Areas, the Split Rock and Deer Creek Antelope Hunt Areas, and the Muskrat Elk Hunt Area are located within the GHPA. Hunt Areas are defined by a distinct geographic area. Harvest strategies are developed to address specific management issues within specific portions of each unit (**Figures 3.9-2** and **3.9-3**). Despite the higher availability of pronghorn antelope in the GHPA, mule deer are hunted at a higher rate. WGFD (2009b) reports only 79 elk were harvested in the Muskrat Hunt Area, well below the rates for pronghorn and mule deer harvest totals. Due to their relatively low population density, elk are less attractive for hunting in the GHPA and are not further discussed in this section.

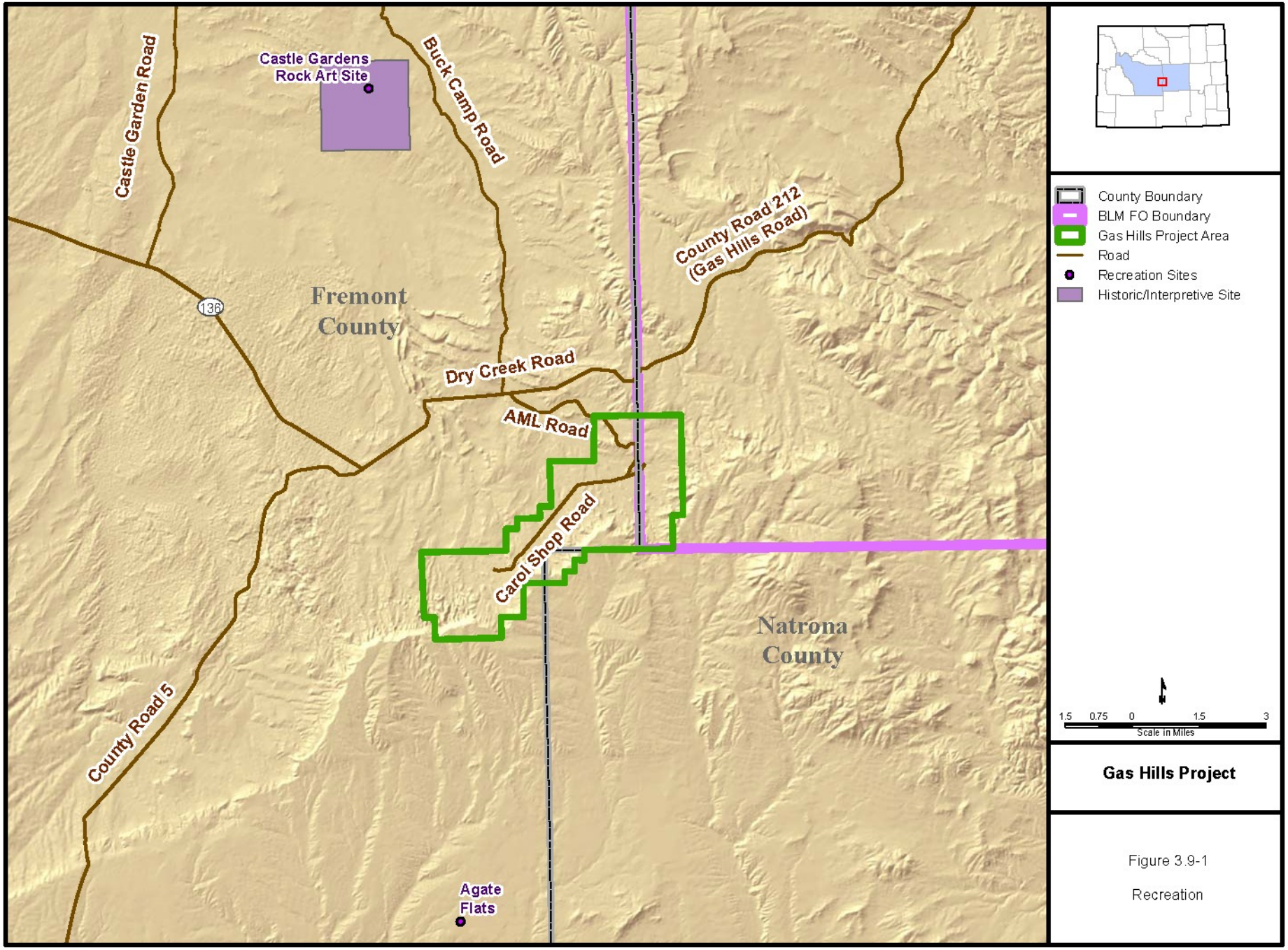
Tables 3.9-1 and **3.9-2** show hunting statistics from 2005 through 2009 for mule deer and pronghorn, respectively; they also detail the percentages of the major Hunt Areas within the GHPA. Big game hunting season typically is from mid-August through early November.

Table 3.9-1 Mule Deer Hunting Statistics

Hunt Area Statistics/Year	Total Mule Deer Harvest	Total Hunters	Hunter Days/Harvest
Muskrat [a]			
2005	49	61	6.7
2006	39	54	5.9
2007	73	64	5.8
2008	87	102	6.2
2009	90	118	7.8

[a] 1 percent of the total Hunt Area is within the GHPA.

Source: WGFD 2009b, 2008, 2007, 2006, 2005.



Gas Hills Project

Figure 3.9-1

Recreation

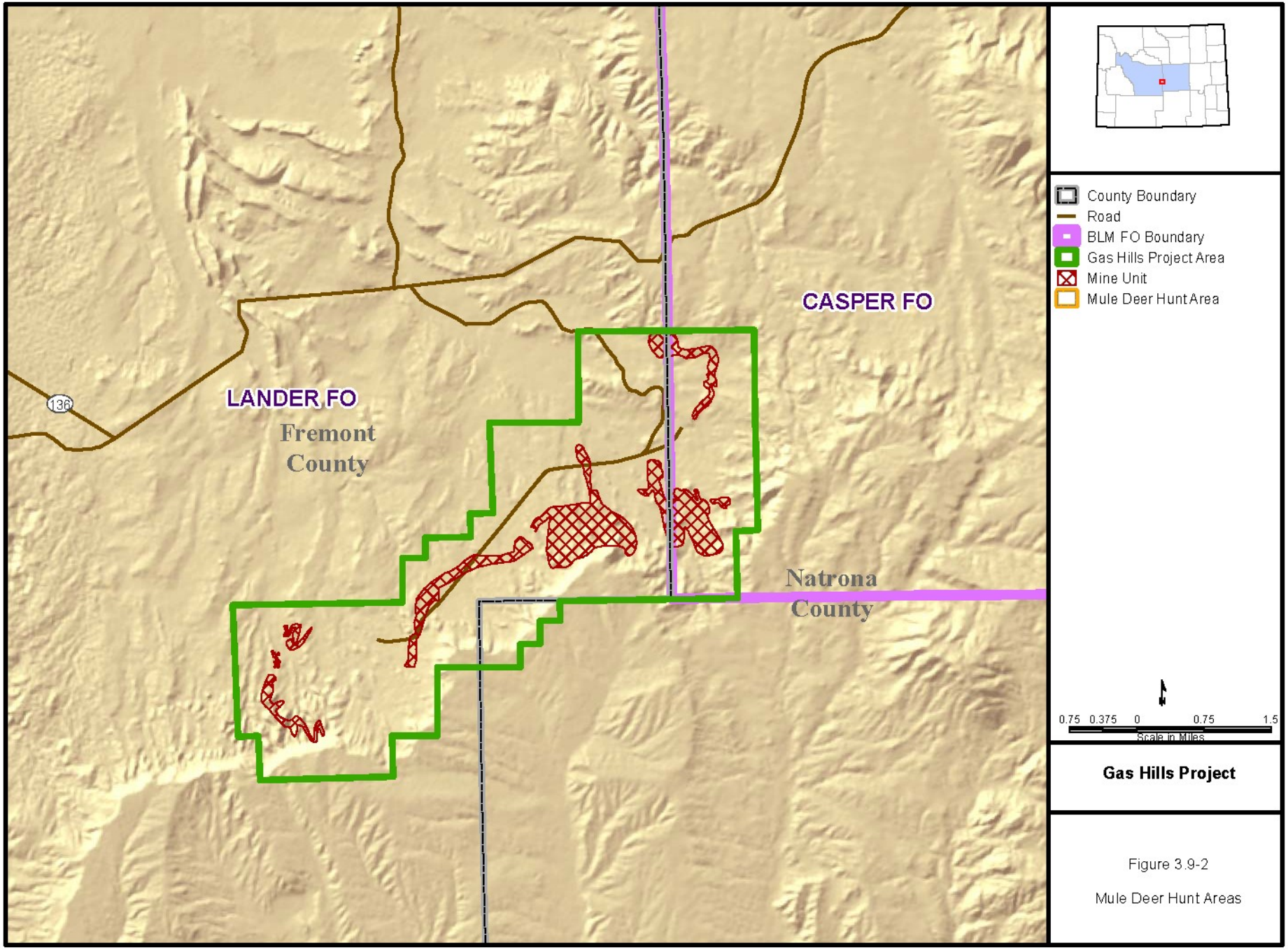


Figure 3.9-2

Mule Deer Hunt Areas

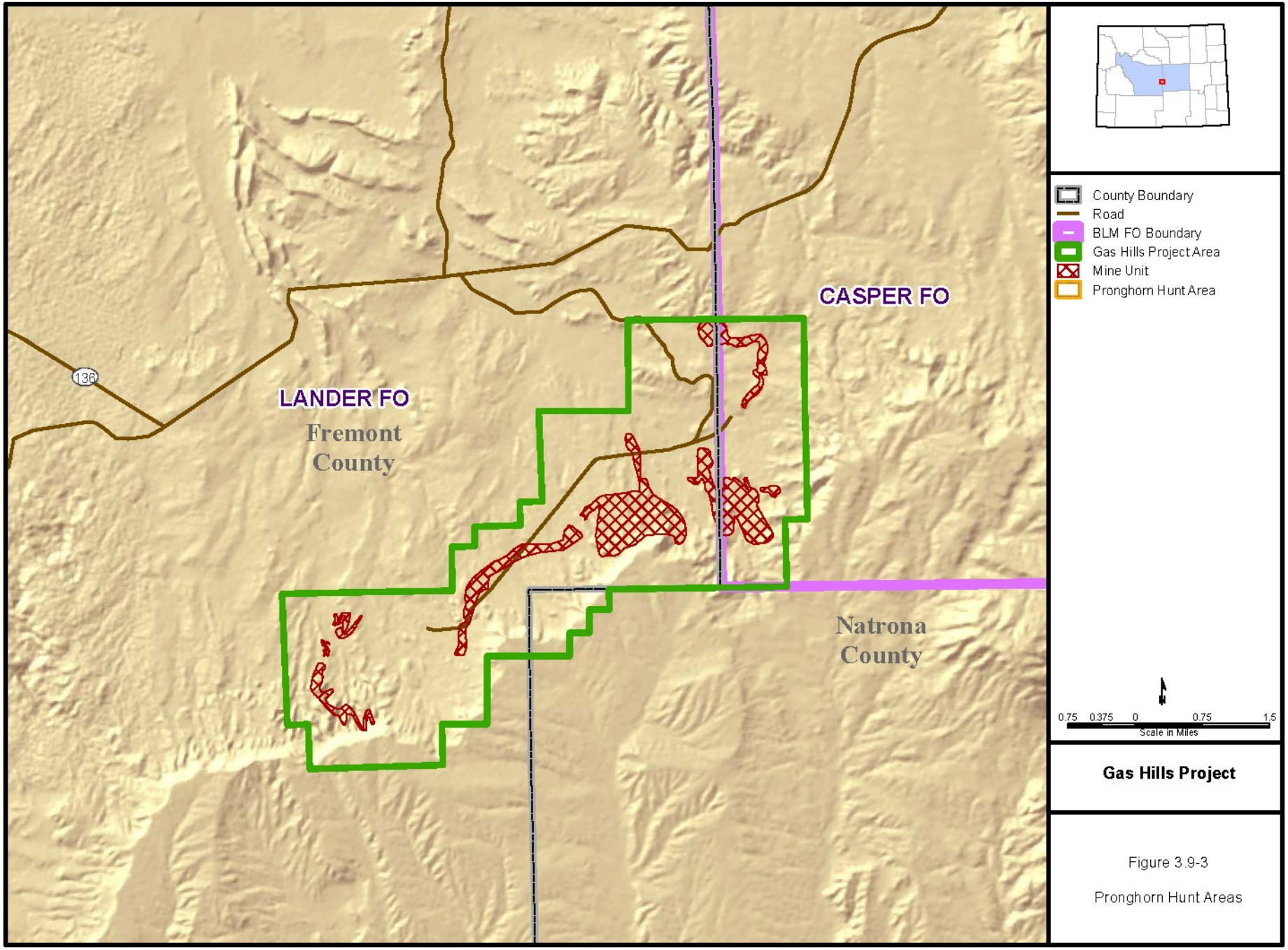


Figure 3.9-3

Pronghorn Hunt Areas

Table 3.9-2 Pronghorn Hunting Statistics

Hunt Area Statistics/Year	Total Pronghorn Harvest	Total Hunters	Hunter Days/Harvest
Split Rock [a]			
2005	216	207	2.5
2006	330	337	2.9
2007	420	438	3.1
2008	388	426	3.3
2009	528	551	3.1
Deer Creek [b]			
2005	157	147	2.7
2006	203	194	3.5
2007	313	285	3.1
2008	314	302	2.5
2009	378	668	2.8

[a] 1.6 percent of the total Hunt Area is within the GHPA.

[b] 2.7 percent of the total Hunt Area is within the GHPA.

Source: WGFD 2009b, 2008, 2007, 2006, 2005.

3.10 Socioeconomics

The study area and cumulative impact study area (CISA) for social and economic values includes Fremont and Natrona counties, and extends into Converse County. The Project is located on the Fremont-Natrona county line with approximately 80 percent of the Project on the Fremont County side of the line. The GHPA is approximately midway between Lander and Casper, which together with Riverton, comprise the 3 largest cities in the area and the most likely to be affected by any potential employment and population effects of the Project. Casper and Riverton are major trade centers for central Wyoming, providing a major portion of the industrial services for the region. These 3 communities would provide labor, services, and supplies and also would house and provide public facilities and services to workers coming into the area to work on the Project. Western Converse County is included in the study area because ore from the Project would be processed into yellowcake at the existing Smith Ranch-Highland facility, located in Converse County, approximately 35 miles northeast of Casper. Effects of the Project on Converse County are expected to be minorl however, because between 6 to 8 employees would be added there, and economic and community resources in nearby Casper are much more substantial than Converse County communities offer. Consequently, the primary focus of this analysis is on Natrona and Fremont counties.

3.10.1 Population and Demography

Wyoming and the 3 study area counties had dramatic increases in population from 1970 to 1980 stimulated largely by energy development. The state and the 3 counties all lost population in the following decade and had only modest annual average growth rates from 1990 to 2000 (**Table 3.10-1**). By 2010, 30 years after the 1980 peaks, Fremont and Natrona counties had recovered and exceeded their 1980 population levels, but Converse County's population still lagged behind its 1980 level by a small margin.

Table 3.10-1 Population Characteristics

Area	1980	1990	2000	2010	Average Annual Percent Change 1980-1990	Average Annual Percent Change 1990-2000	Average Annual Percent Change 2000-2010
Converse County	**14,069**	**11,128**	**12,052**	**13,833**	**(2.3)**	**0.8**	**1.4**
Glenrock	2,736	2,153	2,231	2,576	(2.4)	0.4	1.4
Fremont County	**38,992**	**33,662**	**35,804**	**40,123**	**(1.5)**	**0.6**	**1.1**
Lander	7,867	7,023	6,867	7,487	(1.1)	(0.2)	0.9
Riverton	9,562	9,202	9,310	10,615	(0.4)	0.1	1.3
Natrona County	**71,856**	**61,226**	**66,533**	**75,450**	**(1.6)**	**0.8**	**1.3**
Bar Nunn	NA	835	936	2,213	NA	1.1	9.0
Casper	51,016	46,742	49,644	55,316	(0.9)	0.6	1.1
Evansville	2,335	1,403	2,255	2,544	(5.0)	4.9	1.2
Mills	2,139	1,574	2,591	3,461	(3.0)	5.1	2.9
Wyoming	**469,557**	**453,588**	**493,782**	**563,626**	**(0.3)**	**0.9**	**1.3**

Source: U.S. Census Bureau 2010; Wyoming Department of Administration and Information 2010.

Natrona County, with a 2010 population of 75,450, is the largest of the 3 study area counties by a substantial margin. The county and its largest city, Casper, comprise the major population and economic locus of central Wyoming.

State forecasters predict growth for the next 2 decades for all 3 study area counties and all of the communities in the study area (Wyoming Economic Analysis Division [WEAD] 2012). Notably, the state's forecasts were prepared in 2007 and proved to be too conservative in the short term; the state, all of the counties, and all of the communities tabulated for the study area experienced higher population levels in the 2010 census counts than the WEAD had forecast for 2010.

The study area counties generally are less racially and ethnically diverse than the State of Wyoming as a whole (**Table 3.10-2**). The only notable exception to this is Fremont County, which contains a large portion of the Wind River Indian Reservation. Fremont County's population is 20 percent Native American.

Table 3.10-2 Percent Race and Ethnicity by County

	Converse County	Fremont County	Natrona County	Wyoming
White Not of Hispanic Origin	91.3	71.5	89.1	85.9
Black Not of Hispanic Origin	0.3	0.2	0.8	0.8
American Indian, Eskimo or Aleut Non-Hispanic	0.6	20.0	0.8	2.1
Asian or Pacific Islander Non-Hispanic	0.3	0.4	0.6	0.9
Other or 2 or More Races Non-Hispanic	1.1	2.3	1.7	1.6
Hispanic Origin of Any Race	6.3	5.6	6.9	8.9

Source: U.S. Census Bureau 2010.

Note: Discrepencies in totals are due to rounding.

3.10.2 Economy and Employment

The economy of central Wyoming is supported to a large extent by natural resource development. Much of this reliance on natural resources in Fremont, Natrona, and Converse counties derives from oil and natural gas production and processing, but uranium was a notable contributor in the past and is again becoming more important as demand has increased. There also are notable components of agriculture, recreation and tourism, and government at all levels. Converse County produces coal, much of which is used to generate electric power both locally and nationally. These economic activities are considered to be contributors to the "economic base" of the area because they export goods and services that bring money into the local economy from other areas of the state, nation, and world.

Despite their proximity to each other, each of the 3 study area counties has a different emphasis in its employment base. Converse County is heavily weighted toward the natural resources and mining with more than double the state's percentage of employment working in that sector (**Table 3.10-3**). Converse County is the second highest producer of surface coal in the state. It is Wyoming's only producer of uranium, ranks in the top 10 for both crude oil and stripper oil, and also produces natural gas.

Table 3.10-3 2010 Nonagricultural Wage and Salary Employment by Sector

	State of Wyoming		Converse County		Fremont County		Natrona County	
	No.	%	No.	%	No.	%	No.	%
Goods Producing - Private								
Natural Resources and Mining	27,507	10.1	1,147	21.1	859	5.2	3,298	8.7
Construction	22,352	8.2	521	9.6	976	5.9	2,623	6.9
Manufacturing	8,713	3.2	71	1.3	260	1.6	1,601	4.2
Subtotal	**58,572**	**21.6**	**1,739**	**32.0**	**2,095**	**12.7**	**7,522**	**19.8**
Service Providing - Private								
Trade, Transportation and Utilities	49,301	18.2	862	15.9	2,722	16.6	8,132	21.4
Information	3,881	1.4	63	1.2	233	1.4	490	1.3
Financial Activities	10,792	4.0	178	3.3	686	4.2	1,892	5.0
Prof. and Business Services	17,192	6.3	174	3.2	662	4.0	2,820	7.4
Educational and Health Services	24,940	9.2	271	5.0	2,208	13.4	5,663	14.9
Leisure and Hospitality	32,622	12.0	559	10.3	1,540	9.4	3,970	10.5
Other Services	7,926	2.9	144	2.6	501	3.0	1,701	4.5
Subtotal	**146,654**	**54.1**	**2,251**	**41.4**	**8,552**	**52.0**	**24,668**	**65.0**
Subtotal - Private	**205,226**	**75.7**	**3,990**	**73.4**	**10,647**	**64.8**	**32,190**	**84.8**
Service Providing - Public								
Federal Government	8,077	3.0	78	1.4	495	3.0	764	2.0
State Government	13,339	4.9	135	2.5	873	5.3	696	1.8
Local Government	44,510	16.4	1,235	22.7	4,426	26.9	4,288	11.3
Subtotal - Public	**65,926**	**24.3**	**1,448**	**26.6**	**5,794**	**35.2**	**5,748**	**15.2**
Total	**271,152**	**100.0**	**5,438**	**100.0**	**16,441**	**100.0**	**37,938**	**100.0**

Fremont County is notable for its unusually high percentage of government employment, particularly local government employment. Fremont County is the 5th highest producer of crude oil among the state's 23 counties and ranks in the top 10 for stripper oil and natural gas production. Nevertheless, the percentage of jobs in the natural resources and mining sector is only about half the state average.

Natrona County employment is heavily weighted toward private sector services, particularly in the trade, transportation, and utilities sector and the education and health services sector. This is to be expected as Casper is the largest city in central Wyoming and is concomitantly a major commercial and service center for the region. Natrona County also is the state's highest producer of stripper oil and ranks 10th for natural gas production.

The combined labor force in the study area counties currently is estimated at 66,729, approximately 62,647 of whom are employed. The remaining 4,082 unemployed individuals represent a 6.1 percent unemployment rate (**Table 3.10-4**). This level is only slightly lower than the 6.2 percent statewide unemployment rate and is notably lower than the national rate, estimated at approximately 9.0 percent for the comparable time period (Wyoming Department of Workforce Services [WDWS] 2011). Two of the 3 counties are below the 6.1 percent aggregate unemployment rate, while Fremont County's rate is somewhat higher (**Table 3.10-4**). Unemployment rates for all 3 counties and the state have improved from the prior month, from a year earlier and from their peak levels in 2009. Although they are all more than 1.0 percent lower than the year earlier period, they are more than double the rates from 2007, except for Converse County where the rate is approximately 66 percent above the 2007 rate. A potentially important consideration regarding unemployment rates is the effect on availability of workers for any new jobs related to the Project.

Table 3.10-4 April 2011 Labor Force, Employment and Unemployment

	Labor Force	Employed	Unemployed	Unemployment Rate
Converse County	7,301	6,950	351	4.8
Fremont County	18,959	17,634	1,325	7.0
Natrona County	40,469	38,063	2,406	5.9
County Totals	**66,729**	**62,647**	**4,082**	**6.1**
Wyoming	290,411	272,493	17,918	6.2

Source: WDWS 2011.

3.10.3 Income

Personal incomes for study area counties are variable compared with the Wyoming level. The average per capita personal income in Fremont County ($38,105 in 2009) is substantially lower than for Converse County ($44,283), or Natrona County ($53,361) and is below the state average of $44,861 (**Table 3.10-5**). The pattern holds largely true for median household incomes as well, except that Converse County leads in that metric. The median household income for the state in 2010 was $53.802. Converse County's median household income was 1.5 percent higher at $54.599, Natrona County's was 5.3 percent lower at $50,936, and Fremont County's was substantially (13.8 percent) lower at $46,397 (**Table 3.10-5**).

Table 3.10-5 Income Levels by County

	Converse County	Fremont County	Natrona County	Wyoming
Per Capita Personal Income (pcpi)	$44,283	$38,105	$53,361	$44,861
Median Household Income	$54,599	$46,397	$50,936	$53,802
Percent in Poverty	7.7%	14.0%	8.4%	9.8%

Source: Bureau of Economic Analysis (BEA) 2011.

As noted previously, natural resource development, particularly oil and gas extraction, is a major contributor to the economy of the study area. The mining sector, which includes oil and gas extraction, is the largest contributor to earned income in Converse County (19 percent of total income) and in Natrona

County (16.9 percent of total personal income). The mining sector is the second largest contributor to earned income in Fremont County, at 5.3 percent of total personal income. Government at all levels combined was the largest contributor to total personal income in Fremont County (21.2 percent), second largest in Converse County (13.3 percent), and third largest in Natrona County (9.5 percent, closely following the health care and social assistance sector).

Total personal income includes non-labor income as well as earned wage income. Non-labor income includes sources such as dividends, interest, and rent, as well as personal transfers such as retirement, disability, insurance, Medicare, and welfare income. Non-labor income sources are significant contributors to personal income in the study area. They provided 31.7 percent, 46.4 percent, and 35.6 percent of total personal income for Converse, Fremont, and Natrona counties, respectively, in 2009 (BEA 2010).

The natural resources and mining sector, which includes oil and gas extraction, is a major contributor to wages in the state and in each of the 3 study area counties. The sector provided nearly 22 percent of total wages in Wyoming with just over 10 percent of total employment. Average annual pay for the sector ranged from 51 percent above the average annual pay for all sectors in Converse County to 82 percent above the average annual pay for all sectors in Fremont County. Construction or federal and state government sectors typically were the sectors with the second highest level of average annual pay, although they lagged well behind the natural resources and mining sectors.

Poverty rates in the study area counties tracked household income levels to a large degree (see Section 3.10.8, Environmental Justice). Figures for 2009 indicate 9.6 percent of state residents had incomes below the poverty level. Rates for Converse, Fremont, and Natrona counties were 6.8 percent, 14.1 percent, and 9.6 percent, respectively.

3.10.4 Housing

The 2010 census found 58,006 housing units in the 3-county study area; 33,807 units, or 58 percent, were in Natrona County; 17,796 units were in Fremont County; and 6,403 units were in Converse County (**Table 3.10-6**). At the time of the census, 51,744 of the housing units were occupied, leaving 6,262 (10.8 percent) vacant. The overall vacancy rate can be misleading; however, as some portion of the vacant units were for seasonal, recreational, or occasional use and not available for people seeking housing. In Natrona County, 30,616 units were occupied and 3,191 (9.4 percent) were vacant. Discounting the seasonal, recreational, and occasional use units, vacancy rates were at a low 1.7 percent in homeowner units, and a more generous 9.1 percent in rental units (U.S. Census Bureau 2010). Vacancy rates were fairly consistent throughout the study area. The vacancy rates for just homeowner units ranged from 1.5 percent in Fremont County to 2.2 percent in Converse County; the overall rate was 1.7 percent for the 3 counties. The vacancy rate for rental units was 8.5 percent for the 3-county area.

Table 3.10-6 2010 Housing Vacancy Rates

Geographic Area	Housing Units				Vacancy Rate by Type (%)	
	Total	Occupied	Vacant	Vacancy Rate (%)	Homeowner Units	Rental Units
Converse County	6,403	5,673	730	11.4	2.2	7.3
Fremont County	17,796	15,455	2,341	13.2	1.5	7.6
Natrona County	33,807	30,616	3,191	9.4	1.7	9.1
Total	58,006	51,744	6,262	10.8	1.7	8.5

Short-term housing opportunities in the study area are available in the major communities. Casper is home to 33 motels and hotels hosting over 2,000 rooms. There are 15 mobile home parks, recreational vehicle parks and campgrounds in the Casper vicinity, several of which are on BLM-administered lands. Riverton has approximately 11 motels and hotels with several hundred rooms, and 2 recreational vehicle parks or campgrounds.

3.10.5 Public Facilities and Services

Law enforcement in the vicinity of the Project is provided by the Fremont County Sheriff's Department, based out of Riverton, and by the Natrona County Sheriff's Department, based out of Casper.

The GHPA is served by emergency response organizations for fire suppression, emergency medical, and ambulance service. Agencies responsible for fighting fires include the Lysite and Battalion No. 1 Volunteer Fire Departments in Fremont County, the Natrona County Fire Department, based in Casper, and the BLM for wildland fires. Ambulance services serving the area include the Fremont County Emergency Medical Service in Riverton and the Wyoming Medical Center Ambulance Service in Casper. Hospitals are located in Riverton and Casper.

3.10.6 Education

There are 11 county school districts in the 3 study area counties. The largest, with an enrollment of 11,772 in the fall of 2010, is Natrona County District No. 1, the only district in Natrona County and the second largest district in the state. Enrollment in the district has varied by only a few percent from year to year in the last 10 years, peaking at 11,835 in 2001 and dropping as low as 11,408 in 2005. Converse County has 2 districts, the nearest to the GHPA being District No. 2 in Glenrock with a 2010 enrollment of 690. Enrollment in the district has fallen gradually from its peak of 792 in 2001.

Fremont County has 8 school districts. The largest are District No. 25 in Riverton, with 2,474 students in 2010, and District No. 1 in Lander, with 1,707 students. Enrollment in District No. 25 has been very consistent over the past 10 years. Enrollment in District No. 1 declined gradually from its peak of 1,933 in 2001 to 1,670 in 2009 before rebounding modestly in 2010. Enrollments in Fremont County's other districts are much lower, ranging from 195 in Dubois' District No. 2 to 563 in Ethete's "Wyoming Indian Schools" District No. 14.

3.10.7 Public Finance

Mineral production in Wyoming, including uranium production, is taxed 2 ways: by a state severance tax and by county ad-valorem property taxes. The Wyoming Department of Revenue (WDR) determines and certifies the taxable value of mineral production for each mineral and each county based on the market value of the mineral minus certain qualifying production costs such as processing and transportation costs (Sachse 2011). Severance taxes are levied on uranium production at the rate of 4 percent of the taxable value (WDR 2010). The taxable value also is certified to the producing county, which collects the ad valorem tax based on the county's mill levy. The mill levy is set by the county each year through its budget process.

Converse County was the only producer of uranium in Wyoming in 2009. A total of 1.9 million pounds of uranium was produced in 2009 with a taxable value of $22.7 million (WDR 2010). This was approximately 0.2 percent of the taxable value of all minerals produced in Wyoming in 2009. Surface-mined coal, along with oil and natural gas, provide the largest taxable mineral valuation in the state. Taxes on the 2009 uranium production included ad valorem taxes of $1.4 million and severance taxes of $0.9 million.

All 3 study area counties produce substantial amounts of crude oil, stripper oil, and natural gas. Converse County also is the second highest producer of surface-mined coal in Wyoming, albeit production from the county is less than 7 percent of the largest producer, Campbell County.

Severance taxes on mineral production in Wyoming are distributed according to a legislatively approved formula. A substantial majority of the revenues are transferred to the state general fund, the state's budget reserve account, and the Permanent Wyoming Mineral Trust Fund (WDR 2010). Approximately $20.9 million was distributed among the state's cities, towns, and counties in fiscal year 2009.

Fremont County adopted a budget of $38.9 million for 2011-2012, $11.4 million of which is planned to come from ad valorem taxes based on a levy of 12.0 mills. Fremont County's total assessed valuation for 2010 was $764.6 million, including both taxable value of minerals and the value of other properties in the county. Natrona County has adopted a 2011-2012 budget of $49.9 million, anticipating ad valorem tax revenue of $13.9 million. Natrona County's total assessed valuation for 2010 was $1,034.6 million.

3.10.8 Environmental Justice

Since publication of EO 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" in the *Federal Register* on February 11, 1994 (59 *Federal Register* 7629), federal agencies have been developing a strategy for implementing the order. Currently, federal agencies rely on "Environmental Justice: Guidance Under the National Environmental Policy Act" (guidance), prepared by the CEQ (1997), in implementing EO 12898.

EO 12898 "is intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority communities and low-income communities access to public information on, and an opportunity for participation in, matters relating to human health and the environment. As required by EO 12898, the Project must be evaluated for any disproportionately high and adverse human health or environmental effects on minority communities and low-income populations.

The environmental justice study area is the same 3-county area as the socioeconomic analysis study area.

3.10.8.1 Minority Populations

EO 12898 defines minority groups as: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic/Latino origin; or Hispanic/Latino. CEQ guidelines for evaluating potential adverse environmental justice effects indicate minority populations should be identified when either: 1) a minority population exceeds 50 percent of the population of the affected area; or 2) a minority population represents a "meaningfully greater increment" of the affected area population than the population of some appropriate larger geographic unit, as a whole.

Majorities of the total populations of both Fremont and Natrona counties classify themselves as White in response to census questions. The largest minority population for Natrona County is Hispanic or Latino, followed by those who identify themselves as being of 2 or more races. Both of these populations were effectively at or below state averages. Blacks represent 0.8 percent of Natrona County's population, the same as the statewide 0.8 percent of the population. Fremont County recorded a 2010 American Indian population of 20.0 percent of the county population, well above the Wyoming state average of 2.1 percent. This would be considered a "meaningfully greater increment" of the Fremont County population for environmental justice concerns. The large American Indian population can be attributed to the Wind River Indian Reservation, most of which lies in Fremont County. The GHPA is not located within the boundaries of the Reservation, the nearest portion of which is situated approximately 30 miles northwest of the GHPA. The next largest minority population in Fremont County is Hispanic or Latino, which, at 5.6 percent of the population, is less than the state average. Converse County is 91.3 percent white; all other racial and ethnic categories represent smaller percentages of the county population than state averages. **Table 3.10-7** summarizes the racial composition and low-income populations of the 3 study area counties.

Table 3.10-7 Racial Composition and Low-Income Populations, 2010

County/State	White Not Hispanic (%)	Black Not Hispanic (%)	American Indian/ Alaska Native Not Hispanic (%)	Asian Not Hispanic (%)	Native Hawaiian/ Pacific Islander Not Hispanic (%)	Other or Two or More Races (%)	Hispanic or Latino of Any Race (%)	Below the Poverty Level (%)	Median Household Income ($)
Wyoming	85.9	0.8	2.1	0.8	0.1	1.6	8.9	9.8	53,802
Converse County	91.3	0.3	0.6	0.3	0.0	1.1	6.3	7.7	54,599
Fremont County	71.5	0.2	20.0	0.4	0.0	2.3	5.6	14.0	46,397
Natrona County	89.1	0.8	0.8	0.6	0.0	1.7	6.9	8.4	50,936

Source: U.S. Census Bureau 2010.

3.10.8.2 Low-Income Populations

Low-income populations are those communities or sets of individuals whose median income is below the current poverty level of the general population. In identifying low-income populations, agencies may consider a community as either a group of individuals living in geographic proximity to each other, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure.

Approximately 14.0 percent, 8.4 percent, and 7.7 percent of households fall below the poverty level in Fremont, Natrona, and Converse counties, respectively (**Table 3.10-7**). The percentage of Fremont County's population with incomes below the poverty level was much greater than the state average of 9.8 percent, while the percentages of Natrona and Converse counties' populations below the poverty level were notably lower than the state average. Fremont County also had median household income that was nearly 14 percent lower than the state average. Natrona County's median household income was slightly below the state average while Converse County's was slightly above the state average. The presence of the Wind River Indian Reservation influences the low median household income and higher level of poverty in Fremont County.

3.11 Soils

A variety of data sources were used to identify the baseline soil characteristics in the GHPA. Information on Major Land Resource Areas and Soil Types was obtained from NRCS literature or databases, including the Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin U.S. Department of Agriculture Handbook 296 (USDA-NRCS 2006) and the Soil Survey Geographic Database (SSURGO). Soil baseline characterization for the Proposed Action and alternatives is based on SSURGO database review and analyses. SSURGO is the most detailed level of soil mapping done by the U.S. Department of Agriculture (USDA) NRCS (USDA-NRCS 2011).

SSURGO soils maps generally are grouped for mapping into units known as soil complexes and soil associations. The primary difference between an association and a complex is scale. An association or complex consists of 1 or more major soils and some minor soils. A soil complex has a characteristic pattern that is so intricately mixed or small in size that it is not practical to separate the soils at the standard mapping scale. A soil association has a characteristic pattern of soils on the land surface, largely determined by relief, drainage, slope aspect or other soil-determining factors. Soil characteristics may vary between each component in a complex or association and are listed separately for greater accuracy.

3.11.1 Major Land Resource Areas

The GHPA lies entirely within Major Land Resource Area (MLRA) 34A, the Cool Central Desertic Basins and Plateaus (USDA-NRCS 2006). This area is surrounded on most sides by mountains with elevations ranging from 5,200 to 7,500 feet. Soils were formed in slope alluvium or residuum derived from shale or sandstone. Soils that formed in stream- or river-deposited alluvium are near the major waterways. Generally, the soils are well drained and calcareous. The dominant soil orders in this MLRA are aridisols and entisols. Aridisols form in an arid or semi-arid climate, and are well developed soils that have a very low concentration of organic matter. In contrast, Entisols are considered recent soils that lack soil development because erosion or deposition rates occur faster than the rate of soil development. The average annual precipitation in this MLRA generally is 7 to 12 inches, but ranges from 7 to 32 inches with a freeze-free season of 45 to 160 days.

Soil characteristics such as the susceptibility to erosion and the potential for revegetation are important to consider when planning for construction activities and stabilization of disturbed areas. These hazards or limitations for use are a function of many physical and chemical characteristics of each soil, in combination with the topography, aspect, climate, and vegetation. **Table 3.11-1** summarizes some important soil characteristics to be considered when evaluating the effects of surface-disturbing activities. Explanations of the meanings of each column follow the table.

3.11.2 Soil Types and Constraints

A variety of soils occur across the GHPA. This soil variability stems primarily from a variety of parent materials as influenced by topography, aspect, elevation, vegetation, and differential rates of mineral weathering. GHPA soils formed from alluvium, residuum, slope alluvium, and eolian parent materials derived from sandstones and shales. Soil depths range from shallow to very deep and slopes range from 1 to 70 percent. The pH of surface soils across the analysis area ranges from neutral (7.0) to moderately alkaline (8.4). Several revegetation limitations are listed for the soil map units overlying the analysis area. These limitations include alkalinity, salinity, sodicity, water holding capacity, soil depth, stoniness, and invasive plant competition.

The GHPA consists of approximately 409 acres of disturbed, approximately 894 acres of previously disturbed but reclaimed, and undisturbed soils (PRI 2009, Appendix D; Hayden-Wing Associates [HWA] 2011a). Much of the existing soil disturbance is related to previous mining or exploration. However,

Table 3.11-1 Soil Characteristics in the GHPA

Wind Erodible	Water Erodible	LRP [a]	Hydric	Compaction Prone	Shallow Bedrock	Stony Rocky	Droughty	Total Acres
Fremont County								
0	3,021	2,973	0	2,980	0	610	264	6,468
Natrona County								
0	687	231	0	321	183	681	20	2,051
Total GHPA Acres								
0	3,708	3,204	0	3,301	183	1,291	284	8,518

[a] LRP = Limited Reclamation Potential.

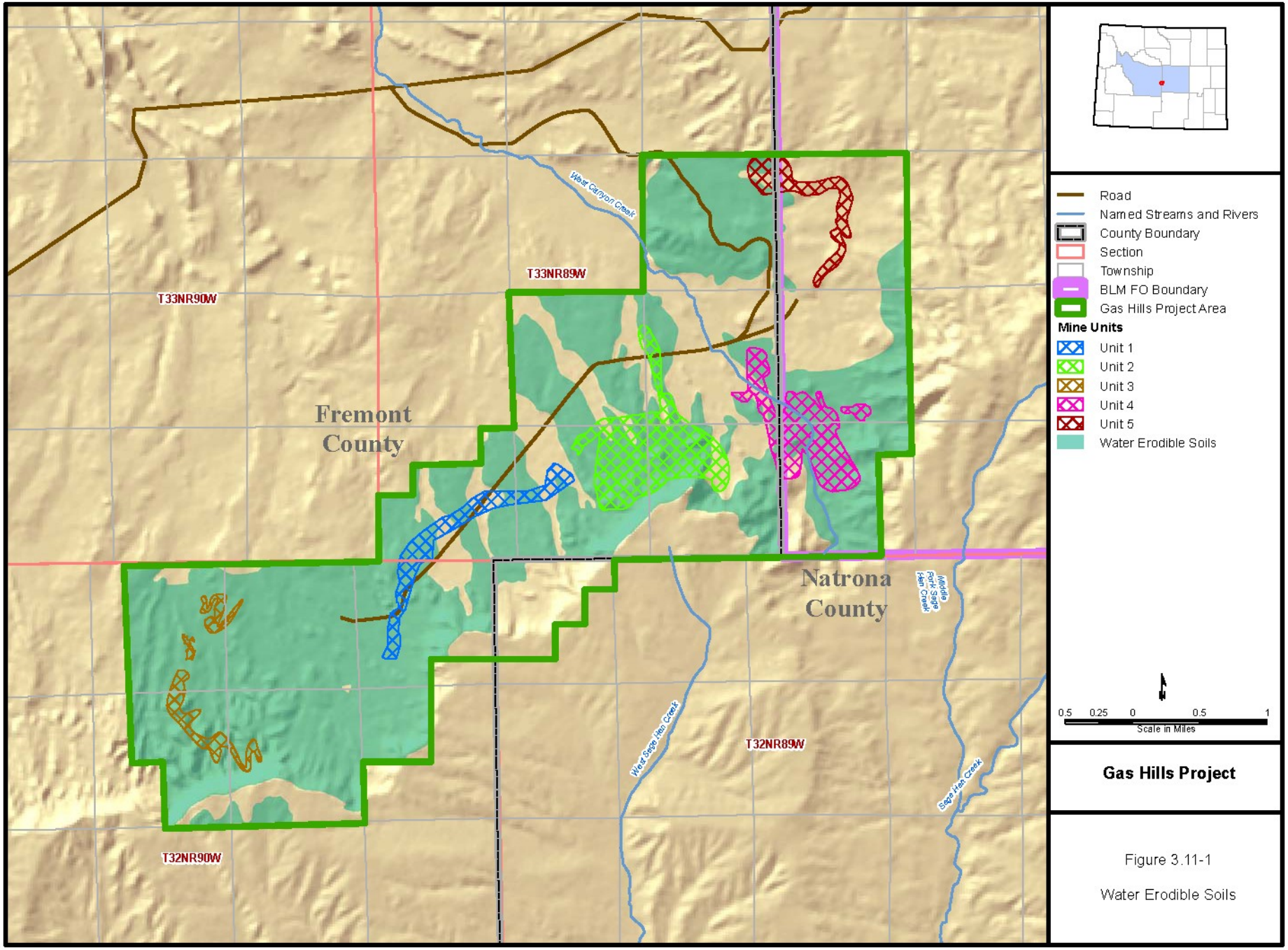
Note: No soils within the GHPA are classified as Prime Farmland. Discrepancies in calculated acreages may occur due to rounding.

disturbance related to recreation (hunting and OHV use) also has contributed to soil disturbance in the GHPA. Disturbed soils can consist of compacted soils, eroded soils lacking topsoil, and soils that have been salvaged and replaced (resulting in soil mixing). The soil quality and productivity of these sites has been negatively altered compared to an undisturbed state. The extent of the degradation of soil quality and productivity depends on the type of disturbance and the biological, physical, and chemical condition of the soil. Previously reclaimed areas have been seeded, but may be revegetated with a non-native grass species and may have been reclaimed with a single species instead of a diverse native plant community.

Several piles of topsoil, originally developed for eventual reclamation of the Carol Shop facility and main roads, are distributed throughout the GHPA and occupy approximately 3 acres. Topsoil excavation, transport, storage, and redistribution modify existing soil structure, generating adverse impacts relative to aeration and permeability. It is likely that some mixing of textural zones has occurred, as well as mixing of saline and/or alkaline materials with relatively salt-free materials. This mixing may create adverse chemical impacts to soil quality for seedbeds. Currently existing microbial populations are likely to have decreased during storage.

Water erosion is the detachment and movement of soil by water. Natural erosion rates depend on inherent soil properties, slope, soil cover, and climate. Approximately 44 percent of the soils within the GHPA are highly erodible to water. Wind erosion is the physical wearing of the earth's surface by wind. Wind erosion removes and redistributes soil. Small blowout areas may be associated with adjacent areas of deposition at the base of plants or behind obstacles, such as rocks, shrubs, fence rows, and roadbanks (Soil Quality Institute 2001). Soils susceptible to wind erosion are not present within the GHPA (**Figure 3.11-1**). However, exposed or loose soils may be prone to wind erosion even if they are not erosion prone.

Limited reclamation potential (LRP) soils consist of soils that have been identified singly or in combination as saline, sodic, or strongly alkaline or acidic. As stated above, these chemical characteristics can severely limit the plant growth. Typically, vegetation that is tolerant or adapted to the soil chemical characteristics is necessary for reclamation. Approximately 38 percent of the GHPA is characterized as having limited revegetation potential soils (**Figure 3.11-2**).



Gas Hills Project

Figure 3.11-1

Water Erodible Soils

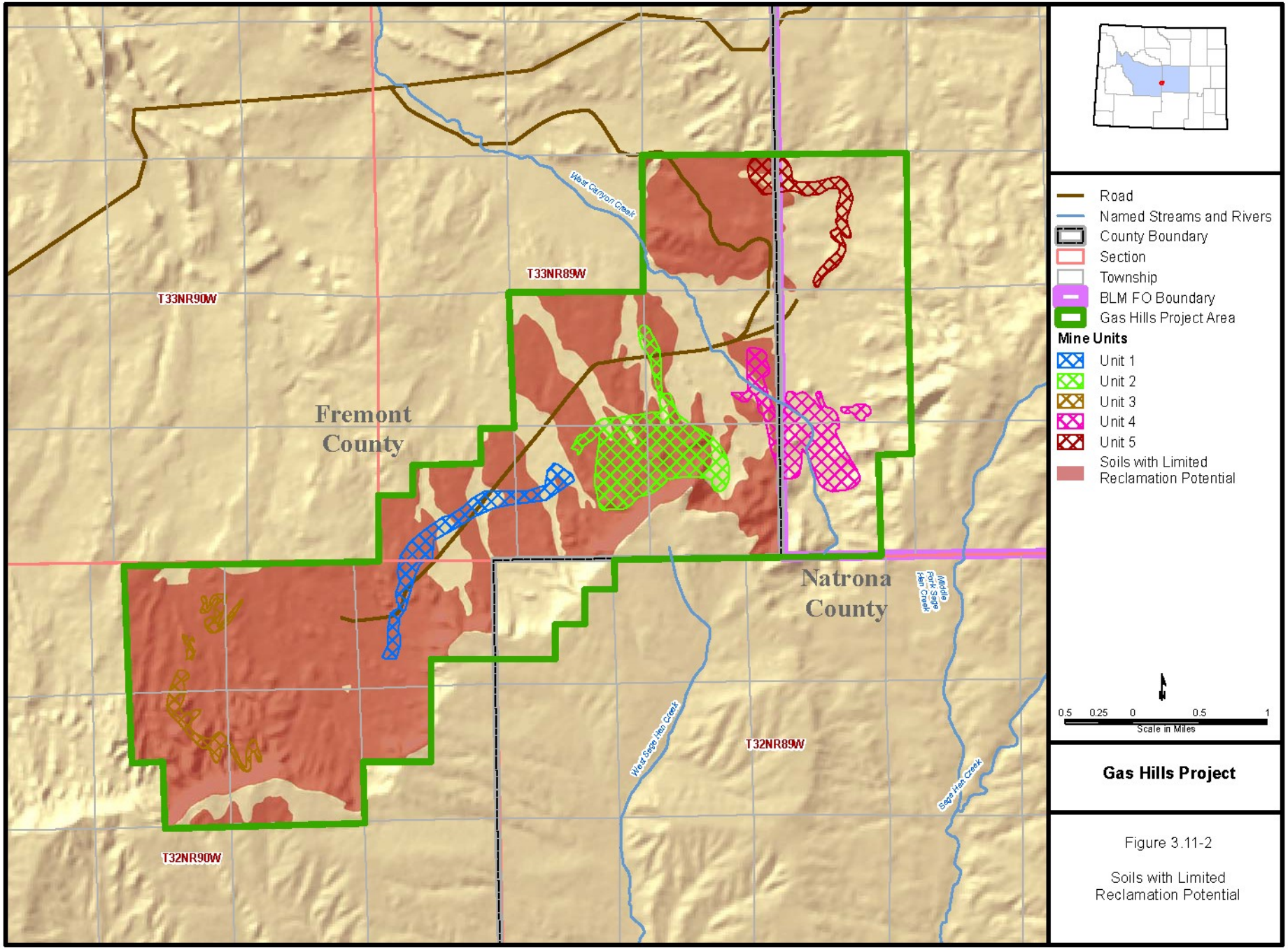


Figure 3.11-2

Soils with Limited Reclamation Potential

Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper portion. These soils commonly are associated with floodplains, lake plains, basin plains, riparian areas, wetlands, springs, and seeps. No hydric soils are mapped within the GHPA; however, due to the scale of mapping, small areas of hydric soils may not be captured.

The USDA-NRCS (2012a) defines prime farmland as land that has the best combination of physical and chemical characteristics for producing crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed. No soils within the GHPA are classified as prime farmland.

Compaction prone soils were identified by identifying component soil series in SSURGO with a surface texture of sandy clay loam or finer. In general, fine textured soils with a high moisture content have low soil strength and are most susceptible to compaction or rutting (**Figure 3.11-3**).

Shallow-to-bedrock soils were identified by soil series with a lithic (hard) bedrock contact listed above 60 inches in depth. The analysis focused on depth hard bedrock which could inhibit pipeline construction related to trenching or spider-plowing.

Stony-rocky soils were identified because they can inhibit pipeline construction and reduce reclamation potential. Soils with significant quantities of stones in the surface were identified by soil series with either:
1) a cobbley, stony, bouldery, gravelly, or shaly modifier to the textural class of the surface layer; or
2) have a surface layer that contains greater than 5 percent (weight basis) stones larger than 3 inches.

Droughty soils were identified by a soil series with a surface texture of sandy loam or coarser and are moderately well to excessively drained. These soils have a low water holding capacity and can be difficult to revegetate and stabilize.

Biological soil crusts are considered an important component in dry arid ecosystems. They provide soil stability, prevent erosion, fix nitrogen, increase infiltration rates, and may reduce noxious weed migration. Biological soil crusts occur throughout the arid west. No site-specific data are available on soil crust coverage in the study area; however, research shows that biological soil crusts do best where sedimentary parent materials are found (Belnap et al. 2003) such as are found in the GHPA.

A soil's stability is greatly affected by the slope on which it occurs. In general, the greater the slope, the greater the potential is for slumping, landslides, and water erosion. Approximately 12 percent (1,047 acres) of the GHPA has slopes of 25 percent or more. Slopes greater than 25 percent are illustrated in **Figure 3.11-4**.

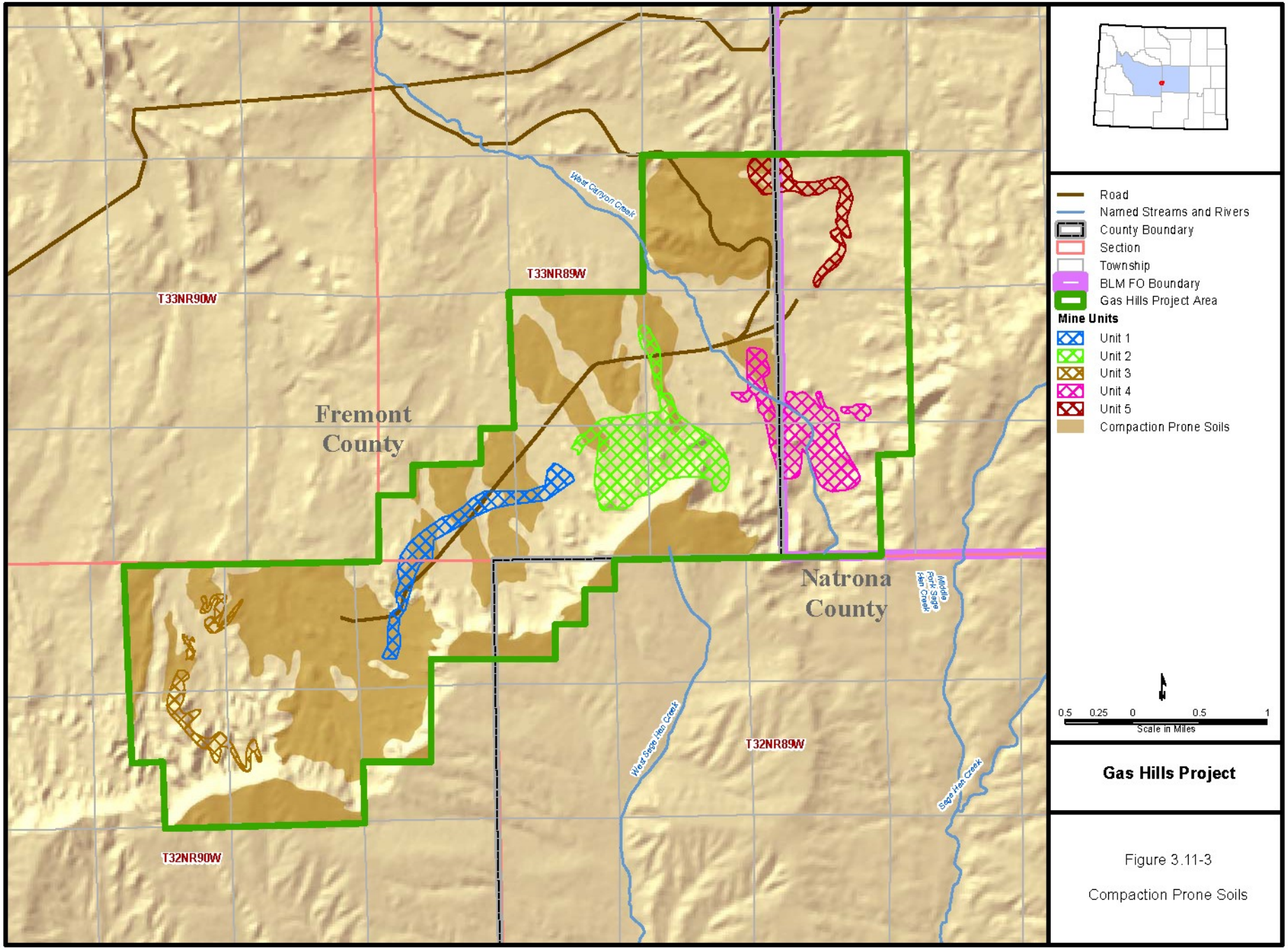


Figure 3.11-3

Compaction Prone Soils

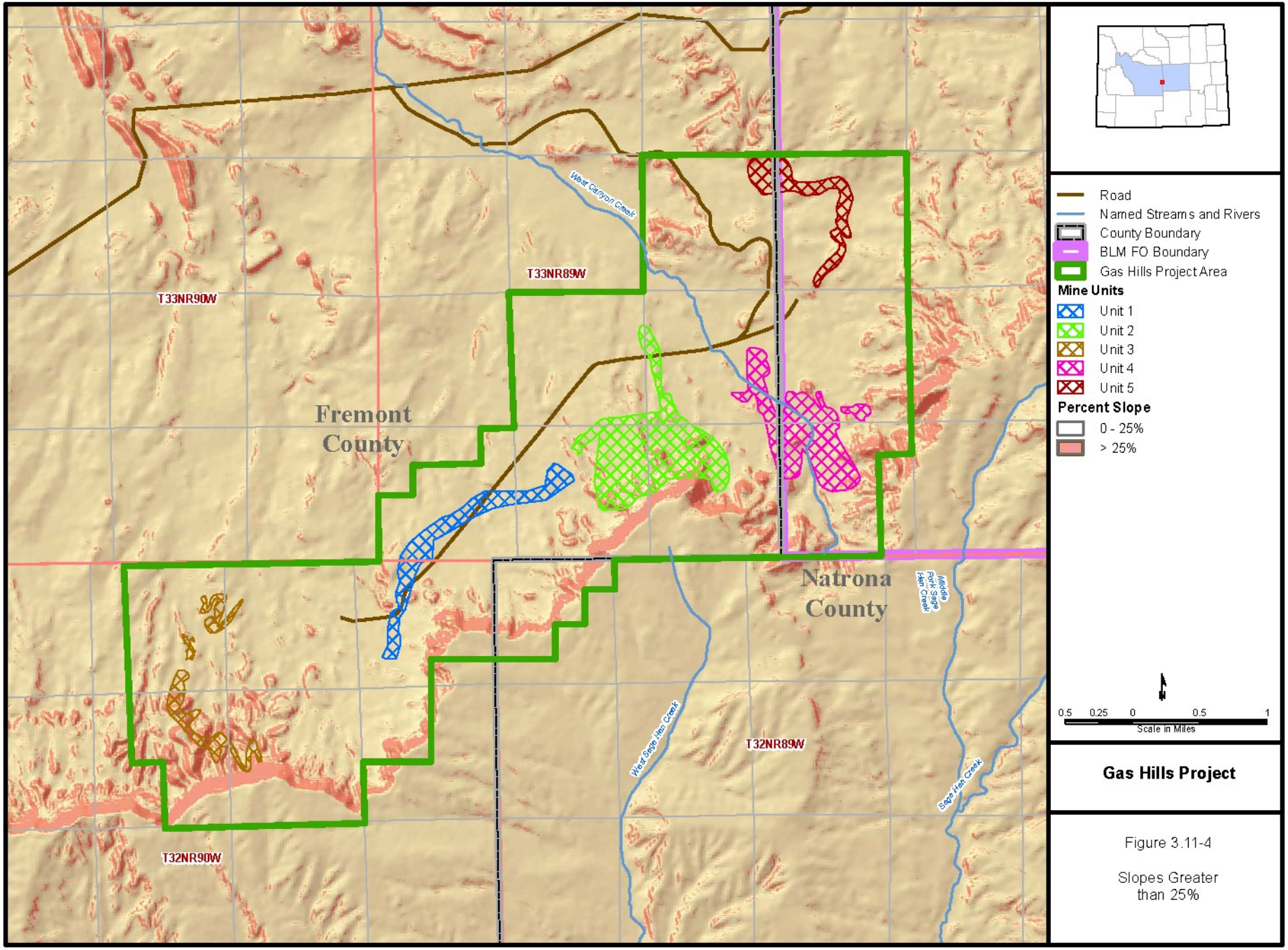


Figure 3.11-4

Slopes Greater than 25%

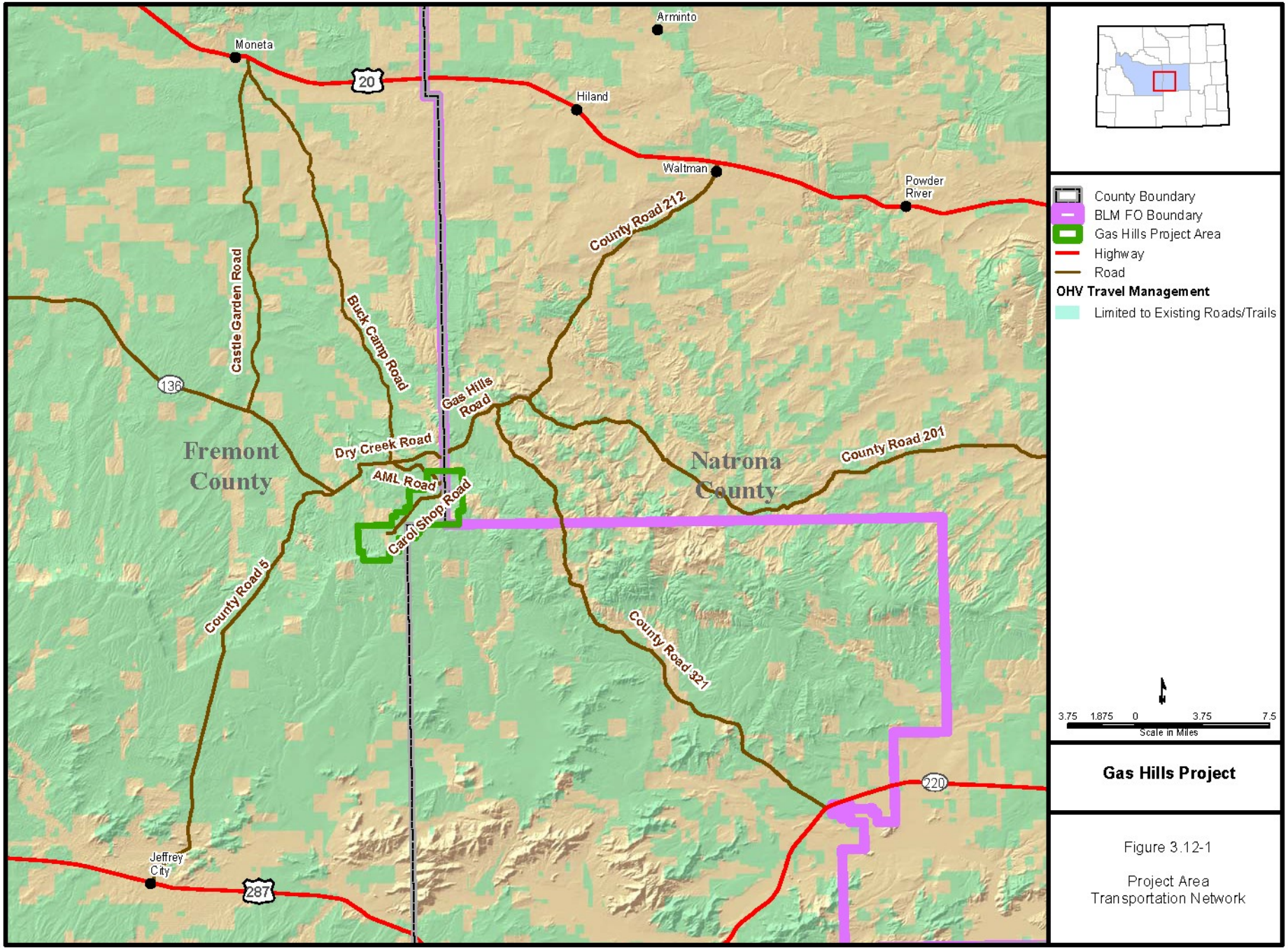
3.12 Transportation

The study area for transportation and access is the GHPA plus regional, county, state, and U.S. highways, as well as the transportation route to the Smith Ranch-Highland facility. The GHPA is located approximately 22 miles south of U.S. Highway 20/26 (**Figures 2-4** and **3.12-1**). As depicted in **Figure 3.12-1**, access to the GHPA is primarily by Wyoming State Route 136, which initiates south of Riverton and terminates just west of the GHPA where it turns into the Ore Road (County Road [CR] 5). Access to the GHPA from the north is via the Castle Garden Road (CR 507), Buck Camp Road (CR 508), and Gas Hills Road (CR 212), all originating from U.S. Highway 20/26. Access to the GHPA from the south is via Ore Road (CR 5), originating from U.S. Highway 287/789.

Transportation routes to the Smith Ranch-Highland facility from the GHPA also are a part of the study area for transportation and access. **Figure 2-5** portrays the Project transportation routes, stretching from Riverton in the west to the Smith Ranch-Highland facility in the east. As depicted in **Figure 2-5**, access to the existing Smith Ranch-Highland facility from Interstate 25 would be primarily by Wyoming 95/93 and Highland Loop Road.

All of the roads within the GHPA are unpaved, and are either BLM or county-maintained, non-maintained public roads, or private. There are approximately 50 miles of roads within the GHPA currently. The majority of the roads in the area are rural and receive light use during Project operation, all of the roads used for the Project in the GHPA would be maintained by Cameco. A summary of traffic counts for roads in the vicinity of the GHPA are provided in **Table 3.12-1**. U.S. Highway 20/26 and State Route 136 recorded increases in traffic from 2000 to 2010 of 39 and 60 percent, respectively. U.S. Highway 287 and State Route 135 (south from Riverton) recorded more modest increases in traffic. The nearest railroad is a Burlington Northern Santa Fe line, approximately 26 miles north of the northern edge of the GHPA.

Under the 1986 Lander RMP, there are areas within the GHPA where OHV travel is designated as either limited, open, or closed to OHV travel. “Limited” OHV areas limit off-road vehicles to existing roads and vehicle routes. As noted in **Figure 3.12-1**, all of the BLM-administered land within the GHPA has been designated as being limited to existing roads and vehicle routes.



Gas Hills Project

Figure 3.12-1

Project Area
Transportation Network

Table 3.12-1 Summary of Current Traffic Volume Near the GHPA

Route	2000 All Vehicles	2000 Trucks	2009 All Vehicles	2009 Trucks	2010 All Vehicles	2010 Trucks	% Change 2000-2010 All Vehicles	% Change 2000-2010 Trucks
U.S. 20/26 at Moneta	2,000	300	2,662	427	2,781	404	39	35
U.S./WY-287/789 east side of Jeffrey City	900	120	1,072	140	1,072	141	19	18
WY-135 MP 17.6 – 34.6	520	70	577	80	570	95	10	36
WY-136 at CR 507 North	130	20	211	20	208	35	60	75

Source: WYDOT 2010.

3.13 Vegetation

The study area for vegetation resources, including general vegetation, noxious weeds, and invasive species, and special status plant species is defined as the GHPA. The following section presents the affected environment for general vegetation resources, noxious weeds and invasive species, and special status plant species within the study area.

3.13.1 General Vegetation

The study area is located in the Wyoming Basin ecoregion. The Wyoming Basin extends from southern Montana into northern Colorado, and includes portions of northeast Utah and southeast Idaho. The arid basin is broad and drained by 3 major river systems; the Green River, the Wind-Bighorn River, and the North Platte. The basin is dominated by grasslands and shrublands surrounded by mountains (Chapman et al. 2004). Common land uses in the ecoregion include livestock grazing, mining, and natural gas and petroleum production (Chapman et al. 2004). The GHPA historically has been mined and is heavily disturbed. Many of the disturbances from historic mining activity are in various stages of reclamation. In these locations vegetation can often be sparse or non-existent, resulting in unstable soils and active erosion. The previously disturbed mine sites are described in more detail under Reclaimed Areas. Non-native grass species common in the GHPA include crested wheatgrass (*Agropyron cristatum*) and cheatgrass (*Bromus tectorum*). Crested wheatgrass was a species commonly used in the reclamation that occurred in the area. Cheatgrass is a prolific seed producer that can invade native communities, displace native plants, and alter the species composition (Colorado State University 2011). Cheatgrass promotes more frequent fires by increasing the biomass and horizontal continuity of fine fuel allowing fire to spread evenly across landscapes where fire was previously restricted to isolated patches (Zouhar 2003).

The topography in the GHPA varies from rolling plains in the north to steep ridges with deep ephemeral drainages in the south (PRI 2009).Vegetation communities were mapped by PRI 2009 Addendum D8 and HWA in 2010. Mapping methodology was based on sampling procedures in the WDEQ-LQD, Rules and Regulations, Guideline 2 and through consultation with the WDEQ (PRI 2009 Addendum D-8). Vegetation communities were delineated based on visual characteristics such as dominant plant species, estimated vegetation cover, landscape position, and major land use. Small vegetation inclusions in larger vegetation communities were not mapped.

There are 8 vegetation communities and land use types mapped in the study area. These vegetation communities and land use types include bottomland sage, mixed sagebrush grassland, rough breaks, reclaimed areas, wetlands, reservoirs, upland grass, and disturbed land. **Table 3.13-1** summarizes the acreages for each vegetation cover type within the GHPA. The dominant cover types are mixed sagebrush grassland and rough breaks.

Table 3.13-1 Vegetation Communities

Vegetation Communities/ Land Use Types	Acres	Percent of Study Area
Mixed Sagebrush Grassland	3,898	46
Rough Breaks	1,990	24
Bottomland Sagebrush	1,091	13
Reclaimed Areas	894	10
Disturbed Land	409	5
Upland Grass	151	2

Table 3.13-1 Vegetation Communities

Vegetation Communities/ Land Use Types	Acres	Percent of Study Area
Wetlands	71	1
Reservoirs	15	<1
Total	**8,518**	**100**

Note: Discrepancies in totals are due to rounding.

Descriptions of the plant communities for each vegetation cover type are provided in the following text. Community characterizations were compiled based on vegetation community descriptions from survey reports developed by Intermountain Resources in 1994; BKS Environmental Associates in 2008 and 1997; and HWA in 2011. Additional vegetation community characterizations were provided by NatureServe (2011) and the planning documents for the Casper and Lander FO (BLM 2007a, 1987). Species nomenclature is consistent with the USDA-NRCS Plants Database (USDA-NRCS 2012b), the Wyoming Natural Diversity Database (WYNDD 2007), and the Wyoming State Noxious Weed List (Wyoming Department of Agriculture [WDA] 2011). **Figure 3.13-1** illustrates the vegetation cover types present within the GHPA.

Mixed Sagebrush Grassland is the dominant vegetation community in the GHPA comprising almost half of the GHPA (46 percent). The vegetation community is found on a variety of topographies ranging from slight draws to upland sloped areas on moderately deep to deep, loamy soils, or shallow rocky sites. The vegetation, composed of a mosaic of shrubs and grasses, is diverse. Dominant species include big sagebrush (*Artemisia tridentata*), thickspike wheatgrass (*Elymus lanceolatus*), and threadleaf sedge (*Carex filifolia*). Other common shrubs include rubber rabbitbrush (*Ericameria nauseosa*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), and mountain snowberry (*Symphoricarpos oreophilus*). Other grass and forb species include bluebunch wheatgrass (*Pseudoroegneria spicata*), Western wheatgrass (*Pascopyrum smithii*), Sandberg bluegrass (*Poa secunda*), phlox (*Phlox* spp.), and milkvetch (*Astragalus* spp.).

The Rough Breaks vegetation community is found on approximately 24 percent of the GHPA on upland, relatively steep sloped areas, rock outcrops, bare slopes, ridges, hilltops, sideslopes, and draws. The substrate is shallow, rocky, or gravelly soils. Dominant vegetation is sparse. Vegetation provides approximately 50 percent cover, and bare soil and rocks occupy approximately 40 percent of the total cover. The vegetation community is comprised of 2 sub vegetation communities: Rough Breaks East and Rough Breaks West. Rough Breaks East is found primarily along the area of draws and slopes along the Beaver Rim, while Rough Breaks West is primarily found in the southwest portion of the GHPA. The dominant vegetation in the Rough Breaks East sub-community consists of big sagebrush, threadleaf sedge, and thickspike wheatgrass, while in Rough Breaks West, dominant species consist of bluebunch wheatgrass, big sagebrush, and thickspike wheatgrass. In the higher elevations of the GHPA, such as the vegetation community atop of Beaver Rim and east towards the Rattlesnake Hills, there are small stands of juniper and limber pines.

The Bottomland Sagebrush vegetation community comprises 13 percent of the GHPA and is found within drainages and upland areas where deeper soil and moisture are present. Species composition is similar to the Mixed Sagebrush Grassland vegetation community, but there is greater shrub cover (approximately 30 percent) and the overall vegetative cover is greater. Dominant species include big sagebrush, Cusick bluegrass (*Poa cusickii*), and thickspike wheatgrass. Other associated species include Western wheatgrass, bluebunch wheatgrass, thistles (*Cirsium* spp.), and milkvetch.

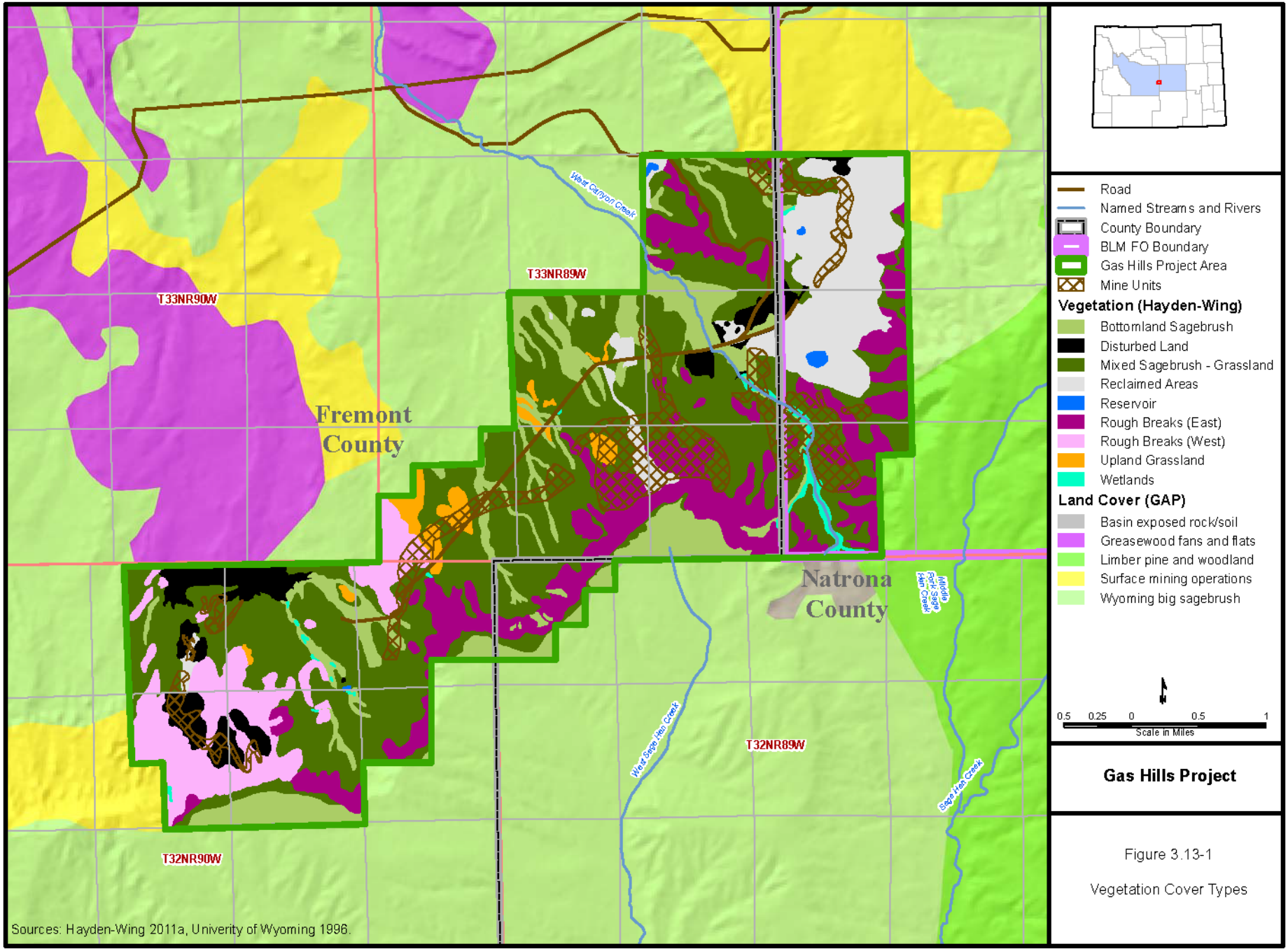


Figure 3.13-1

Vegetation Cover Types

Reclaimed areas cover 10 percent of the GHPA and consist of areas that were previously disturbed but are currently in various stages of succession. Most of the reclaimed areas are found in the northeast portion of the GHPA. Reclamation on these areas was conducted either by the mining companies responsible for the disturbance, or under the Wyoming AML Program. The dominant species are wheatgrasses (*Agropyron* spp., *Pseudoroegnena* spp.), but Indian ricegrass (*Achnatherum hymenoides*) also is common. Non-native grasses and forbs also can be found in these areas. Wheatgrasses, especially crested wheatgrass, were commonly used in seed mixes for reclamation on the areas disturbed by mining. As stated in the Mine Permit Application, quantitative cover information for reclaimed areas located in the proposed disturbed areas would be submitted to the WDEQ-LQD 6 months prior to disturbance. Specific vegetation information was not collected at the time of surveys due to the dynamic nature of reclaimed areas.

Disturbed land comprises 5 percent of the GHPA and consists of areas devoid of vegetation or with limited vegetation due to the development of mining facilities in the area. Mining-related infrastructure and disturbance in the area consists of existing mine pits, topsoil stockpiles, spoil piles, buildings, power lines, and roads.

Upland Grass comprises 2 percent of the GHPA and is found in upland flat areas within the Mixed Sagebrush Grassland that contains somewhat saline soil conditions. Grasses are 30 percent of the total cover, while shrubs are only about 10 percent. Dominant species include threadleaf sedge, birdfoot sage (*Artemisia pedatifida*), and thickspike wheatgrass. Other common shrubs include big sagebrush, rubber rabbitbrush, broom snakeweed (*Gutierrezia sarothrae*), and winterfat (*Krascheninnikovia lanata*).

Reservoirs are less than 1 percent of the GHPA and range in size from small stockponds to large mine impoundments. Several small stock ponds are located in the central and northwest portions of the GHPA, and a small reservoir is located in the southern portion of the GHPA. Vegetation adjacent to reservoirs ranges from seeded grass species to hydrophilic vegetation.

Wetlands are 1 percent of the GHPA and are predominantly found along WCC, which runs northwest to southeast in the eastern portion of the GHPA. The remaining wetlands are found in scattered patches throughout the GHPA. Wetland and riparian communities are areas having persistent water or obligate vegetation (e.g., sedges, rushes, willows) due to the availability of surface or groundwater. Although wetlands and riparian areas comprise a very small percentage of the vegetation communities in the western U.S., their importance to the surrounding ecosystems and associated species is disproportionately great in relation to their size. Most wildlife species use riparian areas at some point in their life cycles and some depend almost entirely on the health of these systems (e.g., many migratory birds during breeding season and amphibians). Riparian areas are the transition between water sources and uplands, and often are rich in vegetation diversity and structure. Riparian and wetland areas act as water purifiers, supply for groundwater recharge, aid in flood control, and in addition to providing food, water, and shade they also may provide cover to wildlife and livestock. Wetlands species in the GHPA include willows (*Salix* spp.), cottonwoods (*Populus* spp.), and boxelders (*Acer negundo*).

3.13.2 Noxious Weeds and Invasive Species

Noxious weeds and invasive species have become a growing concern in the western U.S. based on their ability to increase in cover relative to surrounding native vegetation and exclude native plants from an area. The spread of noxious weeds has resulted in impacts to endangered native species, available forage for livestock and wildlife, and economic resources. They impact the ability of the BLM to manage for multiple uses, contribute to the loss of rangeland productivity, cause increased soil erosion, reduce native species diversity, cause loss of wildlife habitat and, in some instances, are hazardous to human and animal health and welfare. The Federal Plant Protection Act of 2000 (formerly the Noxious Weed Act of 1974) and EO 13112 of February 3, 1999, requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds. Recognizing these regulations, the BLM has established a goal that NEPA

documents consider and analyze the potential for the spread of noxious weed species and provide preventative rehabilitation measures for each management action involving surface disturbance.

The State of Wyoming defines noxious weeds as weeds, seeds, or other plant parts that are considered detrimental, destructive, injurious or poisonous, either by virtue of their direct effect or as carriers of diseases or parasites that exist within the state, and are on the designated list (Wyoming Status, Title 11, Chapter 5, Section 102.a.xi). Noxious and invasive weeds are a threat to native ecosystems and biological diversity based on their ability to increase in cover relative to surrounding vegetation and exclude native plants from an area. In addition to the state designated list of noxious weeds, Fremont and Natrona county have declared weeds of concern specific to each county under the authority of the Wyoming Weed and Pest Control Act (WDA 2011). **Table 3.13-2** provides a list of designated noxious weed species and priority species as identified by the State of Wyoming, as well as Fremont and Natrona counties.

Table 3.13-2 Noxious Weeds Potentially Occurring in the GHPA

Common Name	Scientific Name	State of Wyoming Designated Noxious Weed List[a]	On Fremont (F) or Natrona (N) County Noxious Weed Lists[b]	Observed in the GHPA
Common burdock	*Arctium minus*	X		
Showy milkweed	*Asclepias speciosa*		N	
Cheatgrass/downy brome	*Bromus tectorum*		N	
Hoary cress (whitetop)	*Cardaria draba & Cardaria pubescens*	X		X
Plumeless thistle	*Carduus acanthoides*	X		
Musk thistle	*Carduus nutans*	X		
Diffuse knapweed	*Centaurea diffusa*	X		
Spotted knapweed	*Centaurea maculosa*	X		
Russian knapweed	*Centaurea repens*	X		
Yellow starthistle	*Centaurea solstitialis*		N	
Ox-eye daisy	*Chrysanthemum leucanthemum*	X		
Canada thistle	*Cirsium arvense*	X		X
Field bindweed	*Convolvulus arvensis*	X		
Houndstongue	*Cynoglossum officinale*	X		
Russian olive	*Elaeagnus angustifolia*	X		
Leafy spurge	*Euphorbia esula*	X		
Skeletonleaf bursage	*Franseria discolor Nutt.*	X		

Table 3.13-2 Noxious Weeds Potentially Occurring in the GHPA

Common Name	Scientific Name	State of Wyoming Designated Noxious Weed List[a]	On Fremont (F) or Natrona (N) County Noxious Weed Lists[b]	Observed in the GHPA
Wild licorice	*Glycyrrhiza lepidota*		N	X
Curlycup gumweed	*Grindelia squarrosa*		N	
Halogeton	*Halogeton glomeratus*		N	
Foxtail barley	*Hordeum jubatum*		N	
Black henbane	*Hyoscyamus niger*		N	
Common St. Johnswort	*Hypericum perforatum*	X		
Dyers woad	*Isatis tinctoria*	X		
Perennial pepperweed (giant whitetop)	*Lepidium latifolium*	X		
Dalmatian toadflax	*Linaria dalmatica*	X		
Yellow toadflax	*Linaria vulgaris*	X		
Purple loosestrife	*Lythrum salicaria*	X		
Black medic	*Medicago lupulina*		N	
Scotch thistle	*Onopordum acanthium*	X		
Buffalobur	*Solanum rostratum*		N	
Perennial sowthistle	*Sonchus arvensis*	X		
Swainsonpea	*Sphaerophysa salsula*		F	
Saltcedar	*Tamarix* spp.	X		
Common tansy	*Tanacetum vulgare*	X		
Puncturevine	*Tribulus terrestris*		N	

[a] Source: WDA 2011.

[b] N = Natrona County; F = Fremont County.

For the BLM, while the primary concerns are noxious weeds of concern identified by the State of Wyoming (BLM 2011b), a secondary concern is the control of invasive species (e.g., halogeton, henbane, and cheatgrass) that can impede successful reclamation and impact management of livestock, wildlife, and human activities. Weed treatment on public land is conducted by the land agencies in conjunction with the county weed and pest control districts (Wyoming State Weed Team 2003). These districts develop programs that include private landowners, other local entities and agencies, tribes, state

and federal agencies, as well as collaborate which offers the best chance to protect natural resources from noxious plant invasions and improves the efficiency of their programs.

Within the GHPA, Canada thistle, hoary cress (whitetop), and wild licorice have been observed. Approximately 300 acres of the GHPA have been documented as being infested with Canada thistle. Hoary cress and wild licorice have each been mapped in 1 location within the GHPA. BLM personnel also have observed black henbane, Canada thistle, and Russian knapweed along the access road from the Gas Hills Road to the Carol Shop facility (BLM 2010b). In the vicinity of the GHPA, black henbane, Russian knapweed, perennial pepperweed, Russian olive, saltcedar, and Scotch thistle also have been documented (PRI 2009).

3.13.3 Special Status Plant Species

Special status plant species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species that are protected under the ESA or are considered as candidates for such listing by the USFWS, species that are state listed as threatened or endangered, and BLM sensitive species.

In accordance with the ESA, the lead agency in coordination with USFWS must ensure that any federal action to be authorized, funded, or implemented would not adversely affect a federally listed, threatened, or endangered species or its critical habitat. Special Status Species Management Policy 6840 requires the BLM to manage and protect BLM sensitive species, which include: species listed or proposed for listing under the ESA; species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA; species designated as BLM sensitive by the State Director; and all federal candidate species, proposed species, and delisted species in the 5 years following delisting. This policy requires the BLM to manage and protect BLM sensitive species to prevent the need for future federal listing as threatened or endangered.

Based upon data obtained from agency websites and agency contacts, 19 special status plant species were identified by the USFWS and BLM as potentially occurring within the GHPA (BLM 2011, HWA 2011a,b, PRI 2009). These species, their scientific names, status, associated habitats, and their potential for occurrence within the GHPA are summarized in **Appendix C**. Occurrence potential was evaluated for each of these species based on their habitat requirements and/or known distribution. Based on these evaluations, 13 special status plant species have been eliminated from detailed analysis as their known range is outside of the GHPA, and/or there is no suitable habitat for these species. The species eliminated from detailed analysis are Meadow pussytoes (*Antennane corymbosa*), Laramie columbine (*Aquilegia laramiensis*), Porter's sagebrush (*Artemisia porteri*), Dubois milkvetch (*Astragalus gilviflorus* var. *purpureus),* Many-stemmed spider flower (*Cleome multicaulis*), Owl Creek Miner's candle (*Cryptantha subcapitata),* Williams' Wafer parsnip (*Cymopterus williamsii),* Fremont's bladderpod (*Lesquerella fremontii),*Blowout penstemon (*Penstemon haydenii*), Shoshonea (*Shoshonea pulvinata*), Laramie false sagebrush (*Sphaeromeria simplex*), Ute ladies'-tresses orchid (*Spiranthes diluvialis*), Barneby's clover (*Trifolium barnebyi),* and Desert yellowhead (*Yermo xanthocephalus*). Further detail on why these species were eliminated from detailed analysis is included in **Appendix C.** The remaining 5 species that have the potential to occur within the GHPA are discussed in the following text. Species information was compiled based on the HWA biological field survey report (HWA 2011a,b), the Casper RMP Final EIS (BLM 2007a), NatureServe (2011), and the WYNDD (2011) species accounts. Additional sources are identified in the following text.

HWA conducted field surveys in 2010 for each of the 5 species identified as potentially occurring within the GHPA (**Appendix C**). Survey protocols followed the Cameco Resources Gas Hills Project Wildlife Monitoring Plan approved by the regulatory agencies in 2009 and as requested by the BLM Lander FO.

Surveys to identify suitable habitat for the three ESA-listed species (Ute ladies'- tresses, blowout penstemon, and desert yellowhead) were conducted in 2009 and 2010. No designated critical habitat for these species occurs in the GHPA. Surveys were conducted again in 2010 for the Ute ladies'-tresses

when the nearest known specimen in the vicinity of the GHPA of this species was observed as flowering. Based on these surveys, no suitable habitat was identified in the GHPA.

For the BLM sensitive plant species, surveys were conducted in areas identified as potential habitat for each species based on potential distribution models provided by the WYNDD (HWA 2011a,b). Surveys were conducted in mid to late June 2010 for the BLM sensitive species, near the peak flowering and fruiting periods. Survey sites were randomly distributed throughout the GHPA and were located both in and outside of the modeled habitat areas. At each survey site, meandering pedestrian surveys were conducted within 200 meters of the survey site center-point.

Persistent sepal yellowcress (*Rorippa calycina*) is a Wyoming BLM sensitive species and regional endemic currently only known from the North Platte River drainage, and Bighorn, Great Divide, Green River, and Wind River basins in Albany, Big Horn, Carbon, Fremont, Park, Sweetwater, and Washake counties. Persistent sepal yellowcress is a rhizomatous perennial herb with pubescent stems and foliage, yellow petals, and pubescent ovoid to nearly globose fruits. The species flowers from late May to August, but under favorable circumstances blooming may extend into October. Habitat for the species is primarily found in areas that have periodic flooding such as the high-water line of moist sandy to muddy banks of streams, stock ponds, and man-made reservoirs, high plain swales that evaporate, and along creeks. The species is found from 3,660 to 6,800 feet amsl. There are 28 occurrences in Wyoming, with total populations estimated as ranging from 15,000-25,000 plants. Threats to the species mainly result from changes in water management that reduces the periodicity of flooding, but also include invasion of noxious weeds, herbicide spraying, trampling by livestock, recreation use, and coal mining. Potential habitat for the species was modeled as occurring north of Mine Unit 3 (**Figure 3.13-2**). Suitable habitat was observed along the Gas Hills Road upgrade ROW. No individuals or populations were identified as occurring in the GPHA during surveys.

Cedar Rim thistle (*Cirsium aridum*) is a Wyoming BLM sensitive species and regional endemic that is restricted to the Green River Basin, Sublette County; Beaver Rim area, Fremont, County; Sweetwater River Valley, Carbon County; and highlands east of Flaming Gorge, Sweetwater County. A perennial, taprooted herb with lavender flowers, and brown streaked, cream-colored fruits, it flowers and produces fruit from June to July. Habitat is in sparsely vegetated openings within Wyoming big sagebrush grasslands on barren slopes, fans, and draws. Substrates are sandstone, chalk, tufaceous colluviums, or clay substrates derived from the Split Rock, White River, Wagon Bed, Wind River, Green River, and Wasatch formations. The species is found from 5,800 to 7,500 feet amsl. Populations are estimated to be 40,000 to 50,000+ individuals. Threats to the species include weed management activities for invasive thistles including herbicide spraying, and biocontrol insects (BLM 2011b). Potential habitat was modeled as occurring in the GHPA and southwest and northeast of the GHPA (**Figure 3.13-3**). Suitable habitat for the species was found in the clay slopes and fans within stands of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and grasslands close to the Beaver Rim. No individuals or populations were identified as occurring in the GPHA during surveys. There is a known population of Cedar Rim thistle 2 miles southwest of the GHPA boundary and within the modeled habitat.

Beaver Rim Phlox (*Phlox pungens*) is a Wyoming BLM sensitive species and local endemic in the Wind River and Green River basins extending to the Beaver Rim and southeastern foothills of the Wind River Range in Fremont, Lincoln, Rock Springs, and Sublette counties, Wyoming. There are 2 forms (“typical,” and “Ross Butte morph”) that are split geographically. The typical form is found in Fremont County, and the Ross Butte morph is mainly in the Green River Basin. The species is a leafy perennial forb that forms loose mats of prostrate or short, erect stems and flowers from May to June. Habitat is found on sparsely vegetated slopes on substrates of sandstone, siltstone, or limestone in the Wind River Basin and clays and shales in the Green River Basin. The elevation range is 6,000 to 7,400 feet amsl. There are 31 known occurrences in Wyoming, with populations of 200,000 to 300,000 in the Beaver Rim area and

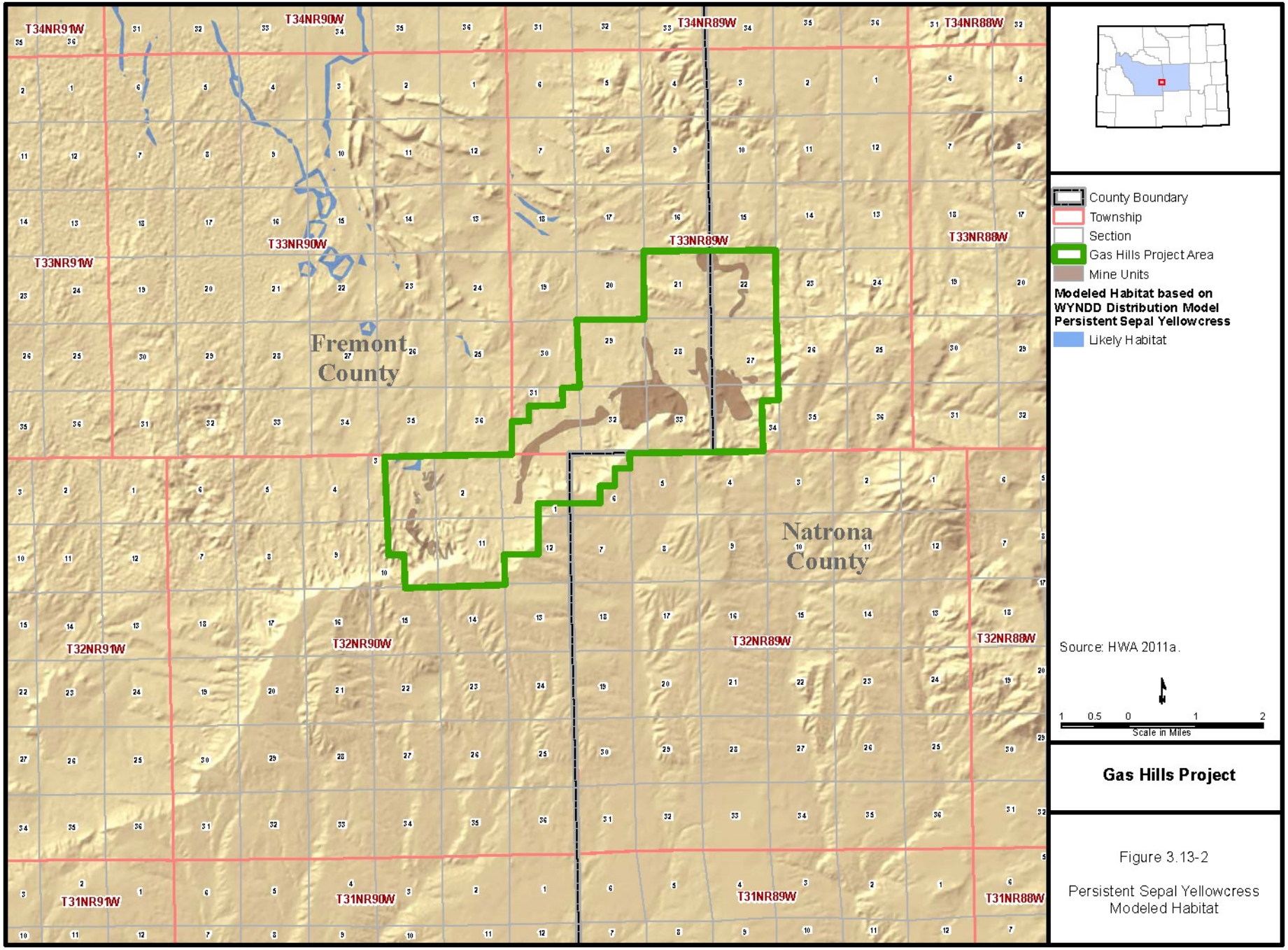


Figure 3.13-2

Persistent Sepal Yellowcress Modeled Habitat

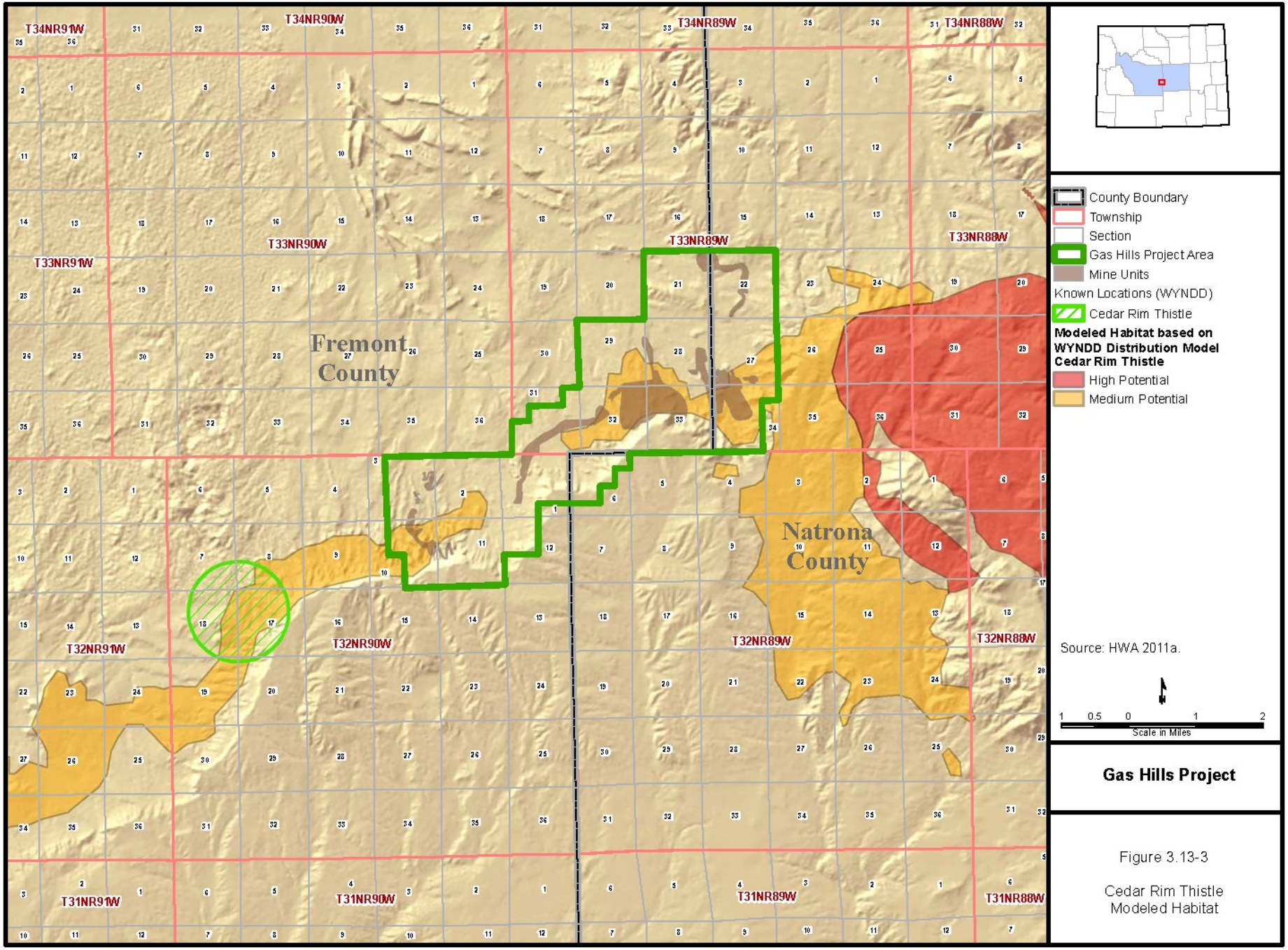


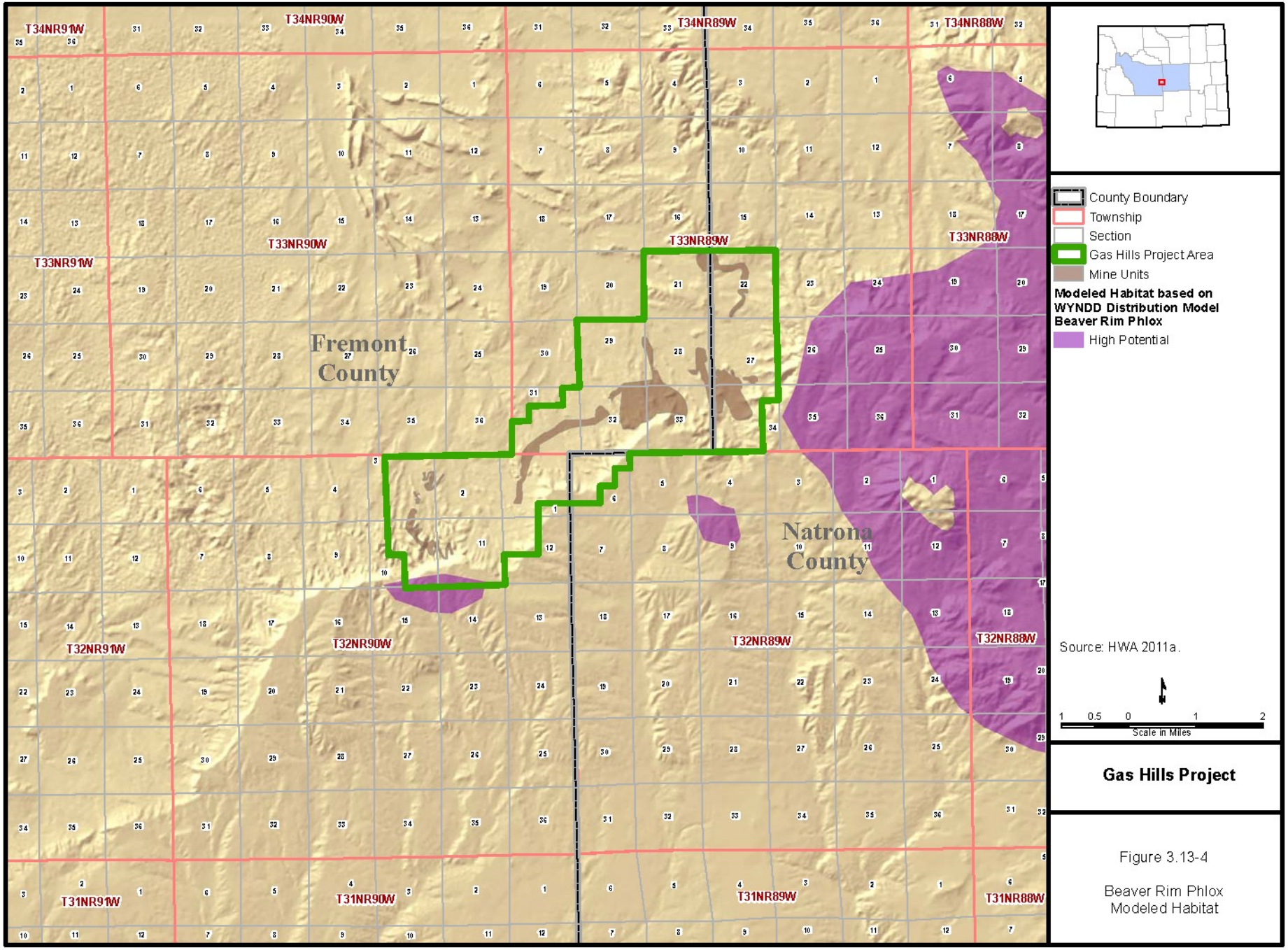
Figure 3.13-3

Cedar Rim Thistle Modeled Habitat

Green River Basin, respectively. Threats to the species include surface disturbance associated with oil and gas development, pipeline and highway construction, off-road vehicle use, and the spread or establishment of noxious weeds and invasive species. Potential habitat was modeled as occurring in the GHPA and south and east of the GHPA (**Figure 3.13-4**). Suitable habitat for the species was found on the slopes and top of the Beaver Rim where there were gaps in the Wyoming big sagebrush. There are no known populations of Beaver Rim phlox in the vicinity of the GHPA. No individuals or populations were identified as occurring in the GPHA during surveys.

Rocky Mountain twinpod (*Physaria saximontana* var. *saximontana*) is a Wyoming BLM sensitive species and state endemic for Fremont, Hot Springs, Carbon, and Park counties. In these counties, the species is found in the southern Bighorn and Wind River basins, and in the foothills of the Wind River and Absaroka ranges. The species is a perennial herb with a basal rosette of gray, green, long-petiole leaves, yellow flowers, and prostrate and decumbent flowering stems. Flowering is from May to late June. Fruits are gray-hairy, inflated, deeply notched at the top and are present from late June to August. Habitat is sparsely vegetated slopes on substrates of sandy, gravelly soils, or talus of limestone, red sandstone, or clay. The elevation range is 5,200 to 8,300 feet amsl. There are 18 occurrences of the species in Wyoming, with populations varying from small and sparse to locally abundant depending on the habitat. Threats to the species include road and pipeline construction or off-road vehicle activity. Potential habitat was modeled as occurring in the GHPA, and southwest, northwest, and east of the GHPA (**Figure 3.13-5**). Suitable habitat for the species was found on the sparsely vegetated portions of the north slope of the Beaver Rim in substrates of clay and gravelly soil. Two known populations of Rocky Mountain twinpod are found in the modeled habitat southwest of the GHPA. No individuals or populations were identified as occurring in the GPHA during surveys.

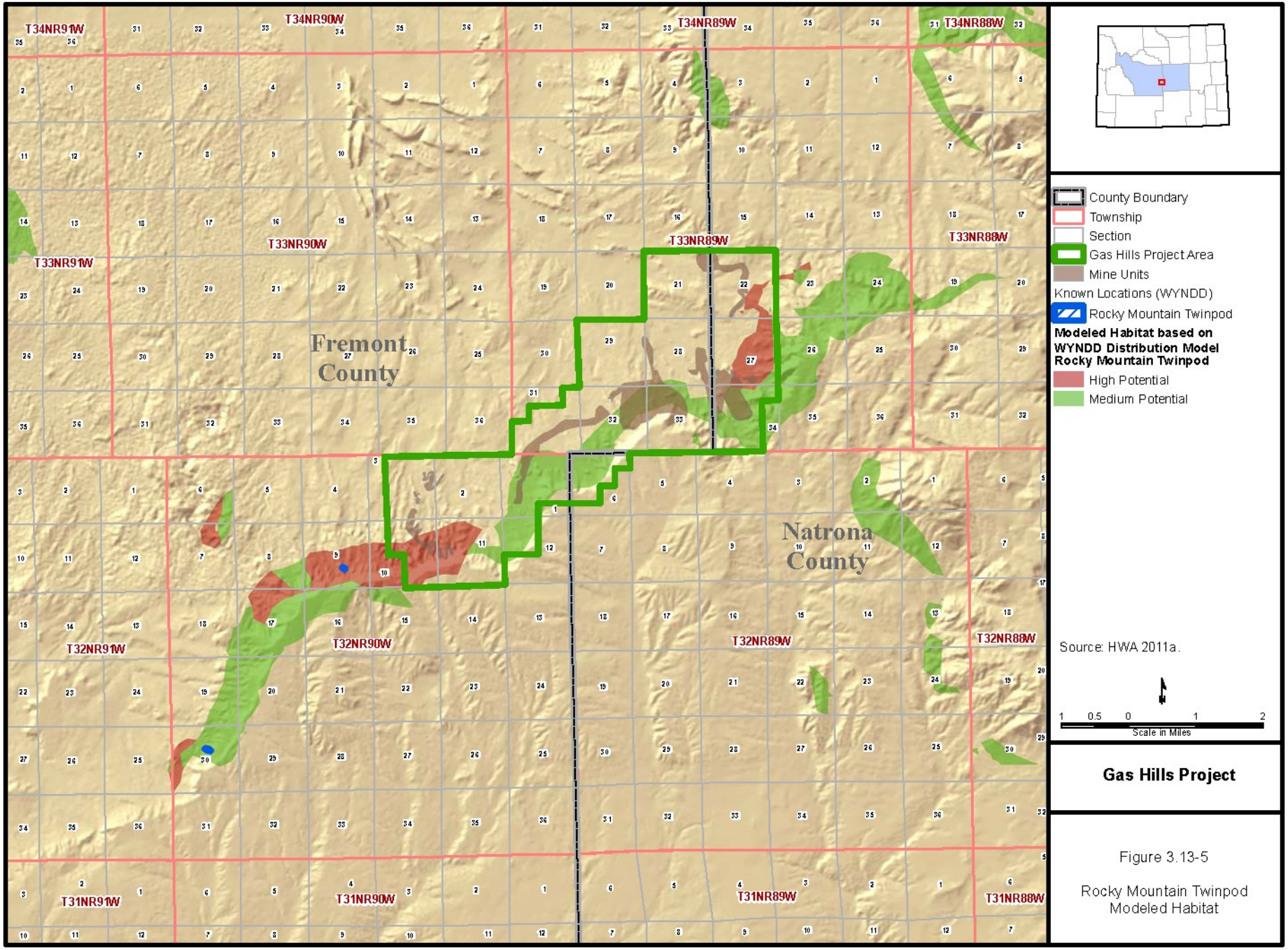
Limber pine (*Pinus flexilis*) is a recent Wyoming BLM sensitive species which is found from Alberta and British Columbia south to California, Arizona, and New Mexico. A long-lived, slow growing tree species, it is rarely taller than 50 feet and often grows in an irregular or multi-stem growth form (Johnson 2001). Flower buds develop late April to late June, while pine cones ripen from August to September. The resulting seeds are dispersed from September to October. Habitat for the tree is typically in dry, rocky sites in forested regions on mesic sites in low density, open areas. In Wyoming, it is usually found with Rocky Mountain lodgepole pine (*Pinus contorta*), Engelmann spruce (*Picea engelmannii*), whitebark pine (*Pinus albicaulis*), Rocky Mountain Douglas-fir (*Pseudotsuga menziesii*), subalpine fir (*Abies lasiocarpa*), Rocky Mountain juniper (*Juniperus scopulorum*), and common juniper (*Juniperus communis*). While specific elevation ranges for Wyoming are not available, elevation range for the species throughout its range is 4,000 to 12,500 feet amsl. Threats to the species include mountain pine beetle infestations, white pine blister rust infections, and climate change (BLM 2010b). Due to the recent listing of this species, habitat modeling and surveys were not conducted for this species. However, the vegetation surveys conducted for the site observed stands of limber pine in the eastern portion of the GHPA.



Gas Hills Project

Figure 3.13-4

Beaver Rim Phlox Modeled Habitat



Gas Hills Project

Figure 3.13-5

Rocky Mountain Twinpod Modeled Habitat

3.14 Visual Resources

The visual resources study area encompasses the area from which the Project would be visible (viewshed) within approximately 5 miles of the Project boundary.

The BLM is responsible for identifying and protecting scenic values on public lands under several provisions of FLPMA and NEPA. The BLM Visual Resource Management (VRM) system was developed to facilitate the effective discharge of that responsibility in a systematic, interdisciplinary manner. The VRM system includes an inventory process, based on a matrix of scenic quality, viewer sensitivity to visual change, and viewing distances, which leads to classification of public lands and assignment of visual management objectives. Four VRM classes have been established, which serve 2 purposes: 1) as an inventory tool portraying relative value of existing visual resources; and 2) as a management tool portraying visual management objectives for each classification. Areas not meeting the objectives of the VRM class established through the inventory and RMP processes for reasons such as being excessively disturbed by previous activities are identified as “rehabilitation areas”. This designation indicates the area needs improvement to comply with visual objectives. **Table 3.14-1** shows the minimum management objectives for each class, based on BLM Handbook H-8410-1, Visual Resource Inventory.

Table 3.14-1 BLM Visual Resource Management Class Objectives

Class I Objective	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
Class II Objective	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic (design) elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
Class III Objective	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
Class IV Objective	The objective of this class is to provide for management activities, which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic (design) elements.

The VRM system also includes a "contrast rating" procedure for evaluating the potential visual effects on the landscape of a proposed project or management activity in the context of other activities that have occurred or may occur in the area in the reasonably foreseeable future.

The viewshed for the Project generally follows drainages to the northwest, including most notably WCC, Fraser Draw, and Willow Springs Draw. The viewshed is interrupted at a distance of approximately 3 miles to the northwest by the Gas Hills. It is truncated by terrain of the Beaver Divide ridge, which runs along the southeast boundary of the GHPA, and by the Rattlesnake Hills approximately 3 miles to the northeast of the permit boundary.

Under the VRM system, the affected environment for visual resources is characterized using an inventory and evaluation process that addresses scenic quality, viewer sensitivity, and distance between viewers and any proposed modification to the landscape. The results of the 3-step inventory process are used to determine which of 4 possible VRM classes should be assigned to BLM-managed public lands by applying a standard matrix to combine the inventory data. Each VRM class has specific objectives giving guidance as to how the visual environment may be managed on lands so designated (**Table 3.14-1**). Landscape characteristics contributing to the inventory process for the GHPA are described below, followed by VRM class designations for the visual area of influence.

The GHPA is located in the Wyoming Basin physiographic province, as defined by Fenneman (1931), which is a landscape defined by horizontal layers of sedimentary bedrocks, often of multiple colors. Some of these areas have striking eroded formations (called “badlands”) interspersed between areas of low, rolling terrain and flat-topped hills. The landform in the Project vicinity is generally low, rolling hills cut in places by drainages. The terrain broadens out and flattens to the northwest, beyond the low Gas Hills. The most notable landform in the area is the Rattlesnake Hills ridge to the northeast, which rises to nearly 8,000 feet amsl.

Regional vegetation tends to be shrubby and sparse, dominated by sagebrush, greasewood, and saltbush. Higher elevations have patches of conifer and aspen. There also are cottonwood groves along some larger drainages. There are no major water features in the study area of sufficient quality or scale to have a notable effect on the visual environment.

Colors in the landscape vary seasonally. Although spring infuses the area with brighter greens in wet years, the most dominant colors are muted grey-greens and tans, with some darker browns and muted reds where soils or rock outcrops are prominent. There are no landscape features in the visual study area that are rare or unique to the Wyoming Basin physiographic province.

The most prominent modifications in the vicinity are remnants of prior uranium mining activities. Previous mining employed primarily surface mining methods, which produced pits and waste rock piles. There also is a network of roads, the most prominent of which are State Route 136 to Riverton, Gas Hills Road (CR 212) to U.S. Highway 20/26, and CR 5 (Ore Road), originating from U.S. Highway 287/789 to Jeffrey City. Other roads in the area are mostly primitive 2-track roads, some of which were exploration access roads. Ranching and agriculture have introduced modifications such as fence lines, corrals, and stock tanks.

Viewer sensitivity to the visual environment in the study area is considered to be low. There are no developed recreation areas to attract recreational viewers and none of the major historic trails across Wyoming pass near the study area. There are no residences in the vicinity. There are no major travel corridors within viewing distance of the visual study area that would bring large numbers of travelers near the Project. Consequently, the number of viewers in the vicinity is small and most viewers in the area are there for work activities related to energy development or ranching. Work related viewers are generally not considered to be highly sensitive to visual resource conditions.

The BLM has conducted visual inventories of the GHPA under the VRM system and established VRM classes in the study area (BLM 2007c,d, 2003) (**Figure 3.14-1**). The Rattlesnake Hills are designated Class III primarily because of better than average scenic quality for the area resulting from more interesting terrain and vegetation. The remainder of the study area is designated VRM Class IV (BLM 2007a). The Lander FO is in the process of revising its RMP. Until that process is complete, the 1987 Lander RMP provides management guidance. The current Lander RMP (BLM 1987) identifies a portion of the visual study area as Class V, however, the BLM Manual Handbook 8410-1 eliminated the Class V designation and areas previously designated Class V are managed as Class IV areas. Class IV areas typically lack distinctive visual qualities and some are highly modified from previous development activities. The scenery is typical of the Wyoming Basin physiographic province described above.

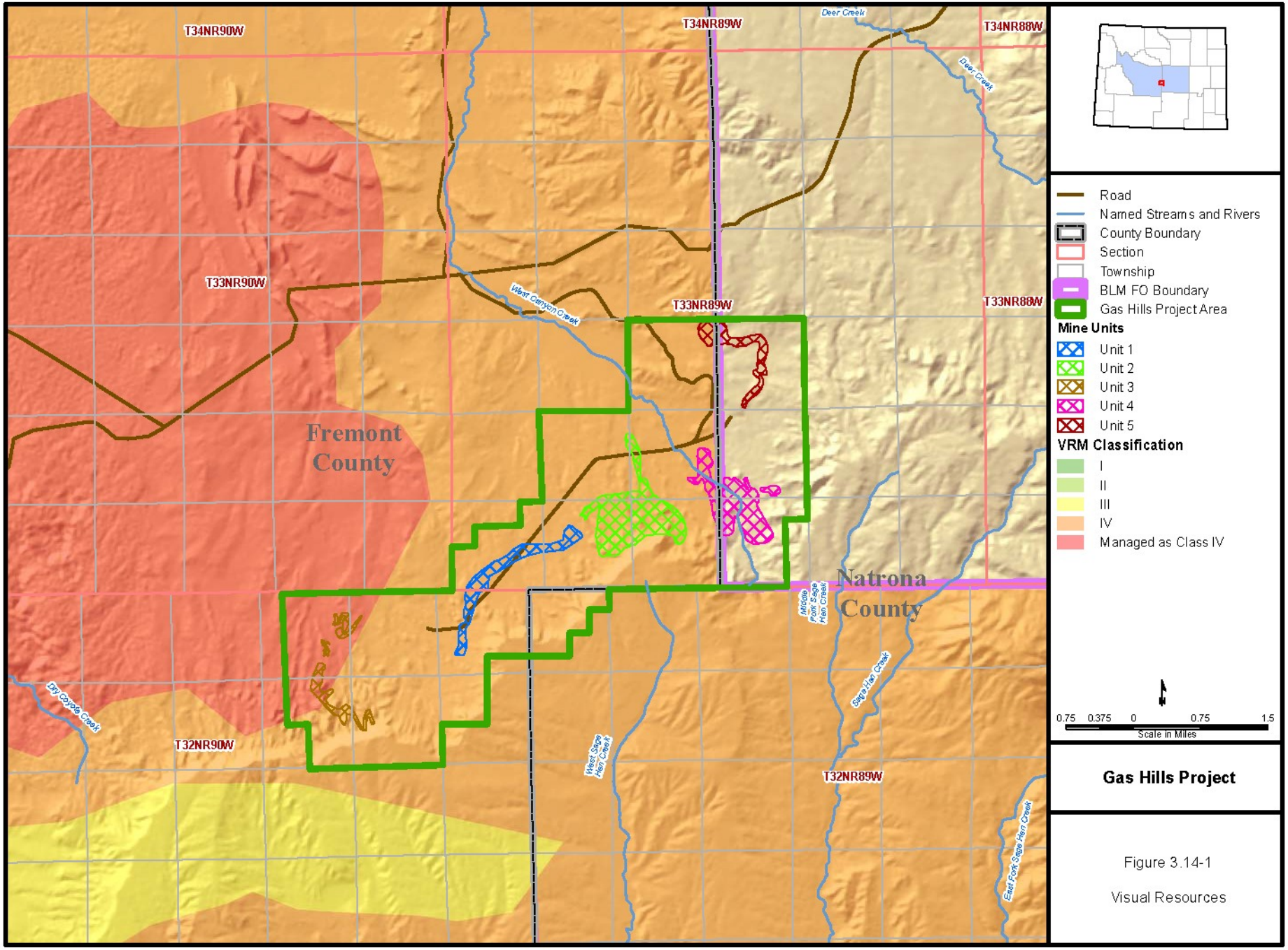


Figure 3.14-1

Visual Resources

3.15 Water Resources

This section summarizes the surface water and groundwater resources currently found in the GHPA. The area has an arid climate with approximately 9.3 inches of average annual precipitation according to 45 years of record at the Gas Hills 4E NWS station. The University of Wyoming's Water Resources Data System online mapper estimates that the higher elevations in the GHPA may receive an average of 11 inches of precipitation annually (University of Wyoming 2011). The months of April, May, and June see nearly half the average annual precipitation, while approximately only 30 percent of the average annual precipitation falls from October through March (WRCC 2011). The NWS estimates that average annual free water (pond) evaporation in this area is approximately 42 inches (Farnsworth et al. 1982).

3.15.1 Surface Water Resources

According to the Watershed Boundary Dataset, the majority of the GHPA is located in the Upper Canyon Creek-Deer Creek and Fraser Draw Hydrologic Unit Code (HUC-12) subwatersheds within the Big Horn Basin, with a small portion in the West Sage Hen Creek and Upper Diamond Springs Draw subwatersheds within the North Platte Basin (USDA-NRCS et al. 2010). These subwatersheds are not known to contain any USEPA, state, or locally designated surface water protection areas (USEPA 2011b; WDEQ 2004). The boundaries and names of subwatersheds within and near the GHPA are depicted in **Figure 3.15-1** and acreages of the GHPA within each subwatershed are tabulated in **Table 3.15-1**.

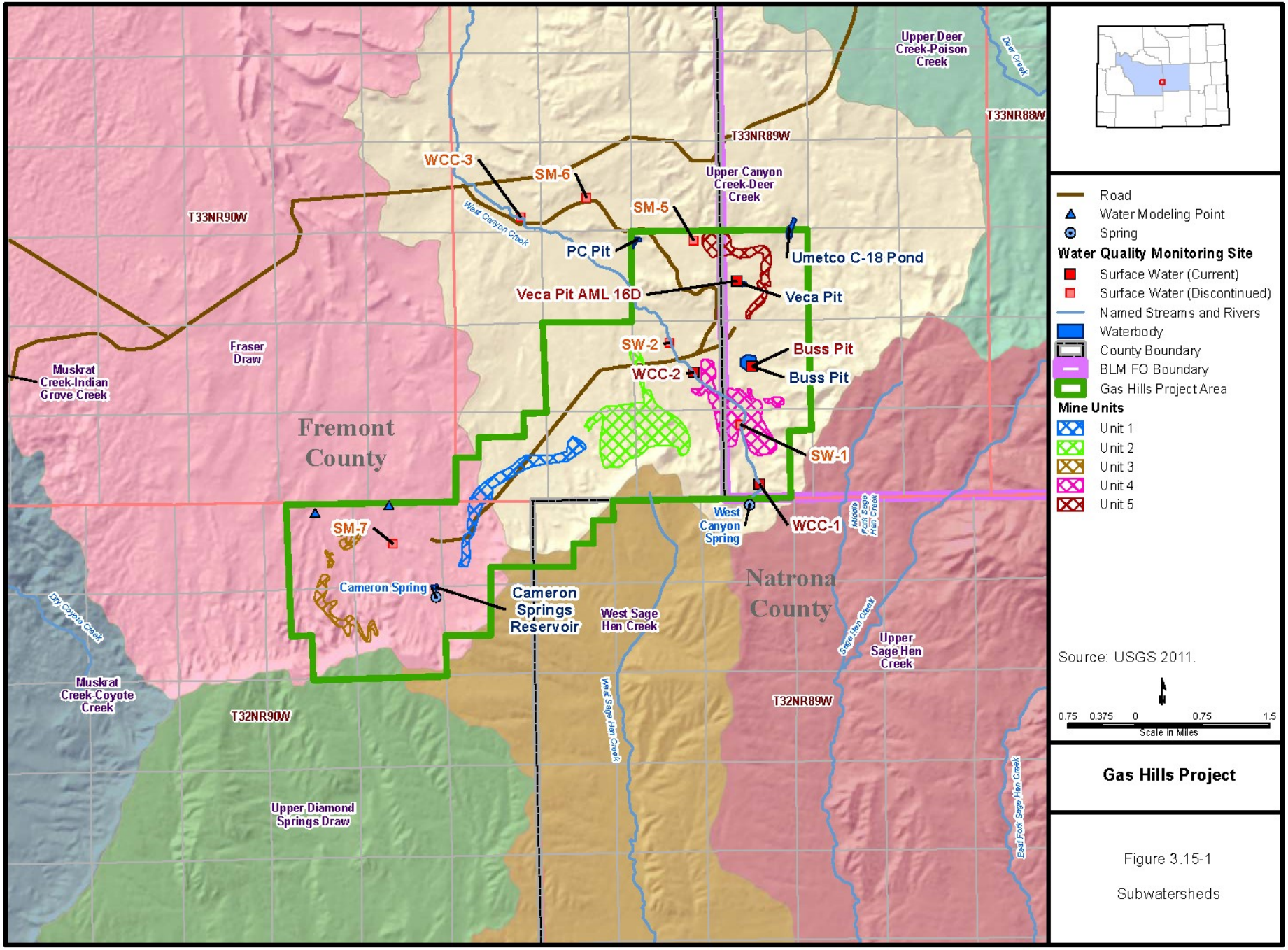
Table 3.15-1 GHPA Location and Acreage According to the Watershed Boundary Dataset

Region	Sub-region	Basin	Subbasin	Watershed	Sub-watershed (HUC-12)	Sub-watershed Acreage	Acres within GHPA
Missouri	Big Horn	Big Horn	Lower Wind	Upper Poison Creek	Upper Canyon Creek-Deer Creek (100800050301)	21,810	5,522
			Muskrat	Upper Muskrat Creek	Fraser Draw (100800040103)	39,558	2,550
	North Platte [a]	North Platte	Sweetwater	Sage Hen Creek	West Sage Hen Creek (101800060704)	23,815	300
				Sweetwater River- Crooks Creek	Upper Diamond Springs Draw (101800060605)	27,212	145

[a] No Project-related disturbance is planned within the North Platte Basin.

Surface drainage within the Upper Canyon Creek-Deer Creek Subwatershed flows toward WCC. WCC is a tributary to Canyon Creek, which is a tributary to Deer Creek, which is a tributary to Poison Creek. Poison Creek empties into Boysen Reservoir on the Wind River.

Surface drainage within the Fraser Draw Subwatershed is toward 2 tributaries within the GHPA named East and West forks of Fraser Draw. Fraser Draw is a tributary to Muskrat Creek; surface flow in West Fork of Fraser Draw is captured by Lake Atlas or the Little Z impoundment which is part of Pathfinder



Gas Hills Project

Figure 3.15-1

Subwatersheds

Mine's operations. Upon Pathfinder's reclamation, runoff from East Fork of Fraser Draw also will be captured by this waterbody.

No Project development would occur in the North Platte Basin (Sweetwater subbasin).

The general drainage of the GHPA is towards the northwest from headwaters located along the Beaver Rim, which runs along the southeastern boundary of the GHPA. Stream channels in the area typically are incised, with active headcutting and gully erosion occurring due to a combination of past mining disturbance, minimal vegetative cover, steep basin slopes, and non-cohesive medium- to fine-grained sand bed materials (PRI 2009).

Streams in the GHPA are classified by the National Hydrography Dataset (USGS 2011b) as all being intermittent; however, evidence through literature review and field reconnaissance indicates these waterways are generally ephemeral in nature, only flowing in response to precipitation events. Exceptions to this are associated with the upper 1.7 miles of WCC and the headwaters of the East Fork of Frasier Draw, where intermittent or perennial flows are exhibited through seasonal or year-round contributions from springs (PRI 2009). Additional stream flow information is included in the following Section 3.15.1.1, Surface Water Quantity.

Waterbodies within the GHPA include mine pits (the Buss Pit, Veca Pit, and the PC Pit), all in the Upper Canyon Creek-Deer Creek subwatershed. Neither the Buss Pit nor the PC Pit are located on stream channels; however, the Veca Pit is located at the headwaters of the East Fork of WCC. Cameron Springs impoundment also is located in the GHPA within the Fraser Draw Subwatershed and on the East Fork of Fraser Draw.

Several surface water monitoring locations have been established in the GHPA as depicted in **Figure 3.15-1**. Permanent stations have been established on WCC consisting of combination v-notch/ cipoelletti weirs; WCC-1 is located in the perennial reach downstream of the spring, and WCC-2 is where the stream becomes ephemeral. Discharge from Cameron Spring in the East Fork of Fraser Draw has been monitored by way of a 3-inch Parshall flume. Monitoring results are discussed below in the subsections on surface water quantity and quality.

Other mapped locations that have been sampled do not have permanent stations because they are located on ephemeral reaches. These locations include WCC-3 which is downstream from the northern GHPA boundary on WCC where the drainage encompasses the portion of the GHPA within the Upper Canyon Creek-Deer Creek Subwatershed. Historic sampling has occurred at numerous sites (i.e., SW-1, SW-2, SM-5, SM-6, SM-7, Buss Pit, and PC Pit) which are reported in this mine's WDEQ Mine Permit Application (PRI 2009) as well as other mine permits. Sites SM-5 and SM-6 are located on the East Fork of WCC, with SM-6 located downstream of the northern Project boundary. Sites SW-1 and SW-2 are located on WCC between WCC-1 and WCC-2, and downstream of WCC-2, respectively. Site SM-7 is located on the East Fork of Fraser Draw.

3.15.1.1 Surface Water Quantity

The upper reaches of WCC Creek exhibit perennial flow due to spring discharge just south of the GHPA in Section 4 of T32N, R89W. Discharge from this spring was measured in 1996 at 9 gallons per minute (gpm), and perennial flow was predicted at the spring.

The headwaters of the East Fork of Fraser Draw contain Cameron Springs, where discharge has been measured at 2 to 3 gpm. The Matador Cattle Company has a permitted water right and the Cameron Springs impoundment directly downstream of this spring captures all discharge (PRI 2009). Section 3.15.3, Water Use, presents additional information on groundwater use.

All other stream reaches in the GHPA are ephemeral in nature and, therefore, only flow in direct response to precipitation events. Several hydrologic analysis points have been established and include

the WCC-3 sampling location, along with sites WFD and EFD which are on the downstream GHPA boundaries of the West and East Forks of Fraser Draw, respectively. These points have been evaluated as key surface water discharge locations from the GHPA and flood volumes have been estimated based on methods for estimating stream discharge in ungauged watersheds. **Table 3.15-2** contains a tabulation of calculated stream discharge and flood volumes at the hydrologic analysis points for specific design storms (e.g., 100-year storm event).

Table 3.15-2 Flood Volumes and Stream Discharge of Recurrence Interval Design Storms

Analysis Point	10-Year		25-Year		50-Year		100-Year	
	Volume (acre-feet)	Discharge (cfs)[a]	Volume (acre-feet)	Discharge (cfs)	Volume (acre-feet)	Discharge (cfs)	Volume (acre-feet)	Discharge (cfs)
WFD	18.3	266.4	27.8	389.5	35.7	490.4	44.8	602.8
EFD-1	21.5	308.3	32.4	448.2	41.4	561.3	51.7	686.8
EFD-2	16.8	246.6	25.5	359.7	32.7	452.0	40.9	554.6
WCC-3	64.0	835.6	101.2	1,269.5	135.3	1,655.5	175.1	2,095.4
WCC-1	17.0	248.8	23.6	335.9	28.7	401.7	34.2	471.3
WCC-2	22.5	321.5	33.4	460.3	42.4	572.7	52.4	696.2

[a] cubic feet per second.

Source: PRI (2009) based on Craig and Rankl 1978 method.

3.15.1.2 Surface Water Quality

The Clean Water Act (CWA), Section 303(c), requires each state to review, establish, and revise water quality standards for all surface waters within the state. To comply with this requirement, Wyoming has developed a beneficial use classification system to describe state-designated use(s). Regulatory programs for water quality standards include default narrative standards, non-degradation provisions, a Total Maximum Daily Load regulatory process for impaired waters, and associated minimum water quality requirements for the designated uses of listed surface waterbodies within the state.

As noted above, surface water use classifications are established by WDEQ in compliance with the CWA. Surface waters within the GHPA are classified as 3B – Other aquatic life, recreation, wildlife, agriculture, industry, scenic value. Section 303(d) of the CWA requires states to list all streams that do not meet their water use classifications, and are therefore considered impaired streams. None of the waterbodies within the GHPA are listed in the 2010 State of Wyoming 303(d) list as a threatened or impaired stream (WDEQ 2010).

Surface water quality in the GHPA is acceptable for livestock and wildlife consumption. TDS concentrations are consistently below 5,000 milligrams per liter (mg/L). Wyoming's surface water standards do not limit TDS for livestock use; however, the groundwater regulations limit TDS to 5,000 mg/L for livestock use (WDEQ-WQD 2005). Metal concentrations often are below detectable limits, and otherwise generally do not exceed livestock water standards. Uranium and radium 226 occasionally have exceeded 5 mg/L and 5 pCi/L, respectively (PRI 2009). USEPA's drinking water standard for uranium and radium 226 are 0.03 mg/L and 5pCi/L, respectively (USEPA 2001); however, because the waters in the GHPA are not classified with a drinking water use, these limits do not apply. For Class 3B waters in Wyoming, no numeric criteria for uranium are established, and the limit for radium 226 is 60 pCi/L (WDEQ-WQD 2007a).

The upper reaches of WCC, where flow is perennial, have been characterized in Cameco's mine permit documents (PRI 2009) as a high quality, calcium-bicarbonate type water that exhibits little variation during base flow conditions between up- and downstream monitoring locations or over time. TDS has ranged from 186 to 337 mg/L (USEPA drinking water secondary standard of 500 mg/L) and the mean of measured pH values is 8.1. Metals have been below detectable levels with the following exceptions; arsenic has been detected in most samples ranging from 0.004 to 0.020 mg/L (human health limit of 0.001 mg/L, not applicable to Class 3B waters [WDEQ-WQD 2007b]). Uranium concentrations have ranged from 0.01 to 0.08 mg/L. Radium 226 concentrations generally have been less than 5 pCi/L, although higher concentrations have been recorded. Cameron Spring is reported to have TDS ranging from less than 200 to a maximum of 786 mg/L and pH of 7.5 to 8.0. Site SM-7 is reported to be similar to Cameron Springs (PRI 2009).

Ponds and reservoirs in the GHPA that have recorded water quality data include the Buss Pit, Veca Pit, and PC Pit. These are all located in the northern GHPA in the Upper Canyon Creek-Deer Creek subwatershed and all contain calcium-sulfate type water with low concentrations of trace metals, some below the detection limit. The Buss Pit has recorded TDS concentrations exceeding 3,000 mg/L and pH of 3.83 standard units (s.u.) (Wyoming criteria range for Class 3B is between 6.5 and 9 s.u.). The Veca Pit has recorded TDS concentrations ranging from 547 to 1,185 mg/L, uranium concentrations ranging from 0.10 to 0.22 mg/L, and radium 226 concentrations ranging from 1.0 to 2.6 pCi/L. The PC Pit has recorded TDS concentrations ranging from 1,303 to 2,796 mg/L, uranium concentrations ranging from 0.20 to 0.56 mg/L, and radium 226 concentrations ranging from 0.9 to 2.1 pCi/L (PRI 2009).

Collection of water quality data during runoff events is scarce, but shows extreme variability. Sites SM-5 and SM-6 have TDS concentrations ranging from less than 100 to over 2,400 mg/L, with pH ranging from 3.3 to 7.6. Uranium concentrations have ranged from 0.006 to 3.2 mg/L at these sites (PRI 2009).

Radium 226 in runoff is reported to show significant variation that is not correlated to mine disturbance. Concentrations have generally been below 5 pCi/L, with 1 anomalous maximum concentration of 372 pCi/L measured at SM-7. The current monitoring sites have yielded concentrations generally below 1 pCi/L, with a high of 17.1 pCi/L measured at WCC-1 (PRI 2009).

3.15.2 Groundwater Resources

3.15.2.1 Regional Groundwater Resources

The Wind River Basin is a northwest-southeast trending structural basin bounded on the east by the Paleozoic rocks of the Casper Arch, on the west by the Precambrian rocks of the Wind River Range, on the north by the Paleozoic and Mesozoic rocks of the Owl Creek Range and the Tertiary rocks of the Absaroka Range, and on the south by the Beaver Rim and the Granite Mountains (Whitcomb and Lowry 1968). Along its axis, the Wind River Basin contains up to 30,000 feet of downfolded and faulted sedimentary rocks ranging in age from Cambrian to recent (Jensen 1972). During the Eocene, high energy streams from the Granite Mountains on the south and the bordering highlands on the west and east formed coalescing alluvial fan deposits that eventually filled the basin. The primary stratigraphic unit formed from these deposits is the Wind River Formation, which contains the uranium deposits within the GHPA.

Groundwater flow in the Wind River Formation Aquifer (Wind River Aquifer) in the south central part of the Wind River Basin (where the GHPA is located) is northwestward toward the Wind River (Whitcomb and Lowry 1968). Groundwater elevations in the south central to southeastern part of the basin range from about 6,900 feet amsl along the Beaver Rim to 4,800 feet amsl along the Wind River. Recharge to groundwater in the Wind River Aquifer is from precipitation and mountain-front runoff from the adjacent bordering highlands of the basin. Discharge is to the Wind River and its major tributaries, the Little Wind River, and the Popo Agie River, which act as groundwater sinks for the Wind River Aquifer.

Groundwater in the Wind River Aquifer occurs under both water table (unconfined) and artesian (confined) conditions (Whitcomb and Lowry 1968). Artesian groundwater conditions are found in the Tertiary and older geologic units, while water table conditions are found in the Quaternary alluvium and in the areas of exposure of older units along the flanks of the basin.

Regional water quality patterns over the Wind River Basin are presented by Whitcomb and Lowry (1968) based on sampling of springs and wells available during their evaluation of the basin. Alluvial aquifers along the Wind River, the Little Wind River, and the Popo Agie river are major sources of water in the basin. Bedrock aquifers in the Wind River Formation can yield substantial water at depths of less than 500 feet. Near the margins of the basin, Cretaceous and pre-Cretaceous units are exposed, and, thus are shallow enough for access by wells for groundwater use, depending on the well yields. In areas of fracturing, these deeper units can provide sufficient water for domestic and agricultural use. Formations that have yielded water are the Park City, Nugget, Tensleep Sandstone, and the Chugwater Formation. Water quality in all geologic units, including the alluvial aquifers, varies considerably throughout the Wind River Basin from groundwater with TDS below 1,000 mg/L to waters with elevated TDS and high sodium and sulfate.

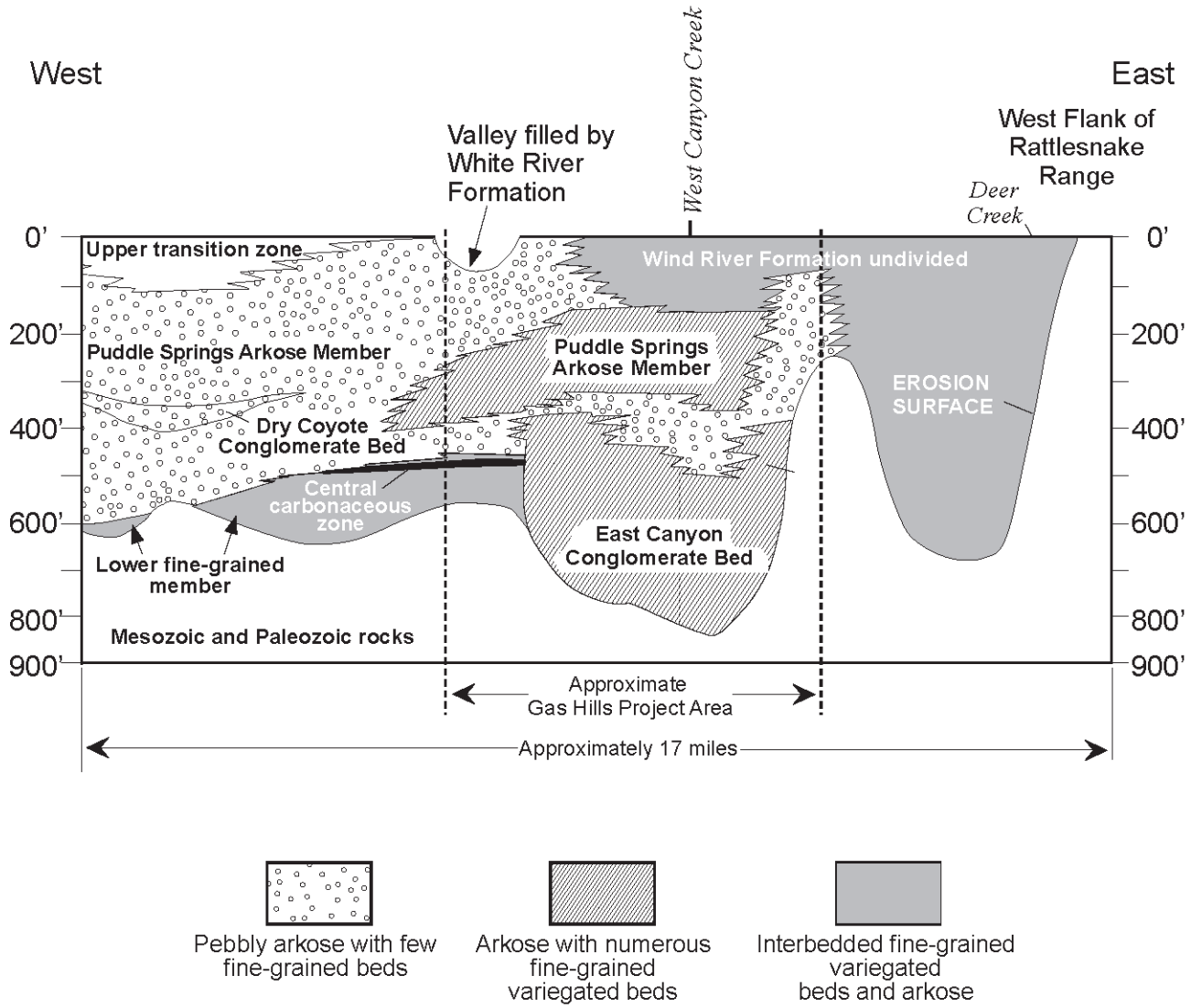
3.15.2.2 Hydrogeology of the GHPA and Vicinity

The GHPA is located in the south central part of the Wind River Basin just north of the Sweetwater Plateau and the Beaver Rim, as shown in **Figure 3.3-1**. The uranium mined historically and the uranium to be mined under the Proposed Action are located in the Eocene Wind River Formation. This formation consists of alluvial fan deposits shed northward into the subsiding Wind River Basin as a result of erosion from the Granite Mountain highlands. This section discusses the geology and hydrogeology of the GHPA and vicinity in general.

Figure 3.3-2 illustrates the geology of the GHPA and vicinity based on mapping completed by Soister (1968) and also compiled from previous mapping in the south central part of the Wind River Basin. The Wind River Formation overlies many older formations and was deposited on these formations after considerable erosion during the Paleocene that formed deeply incised valleys. Subsequent erosion has exposed these underlying geologic units in highland areas to the north and east of the GHPA. Folding that preceded the deposition of the Wind River Formation is evident in the older units exposed in these highlands (e.g., the Gas Hills). Faulting associated with the uplift of the Sweetwater Plateau is observed south of the GHPA, and faulting associated with basin development and subsidence is evident north of the GHPA. The uranium deposits in the Wind River Formation are located, as indicated, by the numerous historic mine workings visible in **Figure 1-1**, within and just north of the GHPA.

In the GHPA and vicinity the Wind River Formation consists of 3 members: 1) a lower grayish-green to gray fine-grained siltstone and sandstone unit with carbonaceous shale and coal; 2) the Puddle Springs Arkose consisting of massive to coarse-grained conglomeratic arkosic sandstone and granite boulder conglomerate; and 3) an upper transition zone that grades into the overlying Wagon Bed Formation and contains numerous beds of tuffaceous and bentonitic mudstone (Soister 1968). **Figure 3.15-2** shows an interpretive geologic cross section along the northern boundary of the GHPA prepared by Soister (1968) based on compiled geologic mapping of the Wind River Basin. The cross section is oriented as shown in **Figure 3.3-1**, and illustrates the relationship of the lower fine-grained member and the uranium-bearing Puddle Springs Arkose. This member is up to 130 feet thick and has carbon-rich (carbonaceous) zones 5 to 15 feet in thickness.

The Puddle Springs Arkose is 400 to 800 feet thick and consists of a massive, coarse-grained conglomeratic arkosic sandstone (coarse sandstone formed by the disintegration of granite) with a granite boulder conglomerate and thin beds of feldspathic sandstone (sandstone derived from granitic-type, primary crystalline, rocks), siltstone, claystone, and carbonaceous shale. Cementing agents include clay, gypsum, limonite, calcite, jarosite, pyrite, black manganese oxides, silica, fluorapatite, and minerals containing selenium arsenic, molybdenum, and uranium (Soister 1968). The arkose is oxidized and grayish yellow above the water table, but blue, green, or gray below the water



Modified from Soister (1968).

Interpretive cross-section showing the geology of the Gas Hills District along an east-west transect, as indicated in Figures 3.3-1 and 3.3-2.

Gas Hills Project

Figure 3.15-2

Schematic Geologic Cross Section

table. The Puddle Springs is host to all the uranium deposits in the GHPA and vicinity, including those to be mined under the Proposed Action. The upper transition member grades into the overlying Wagon Bed Formation and is 50 to 100 feet in thickness.

Groundwater in the Wind River Aquifer in the south central part of the Wind River Basin flows north to northwestward from the Beaver Rim into the central part of the basin, to eventually discharge into the Wind River. In the vicinity of the GHPA, groundwater elevations in the Wind River Aquifer range from around 6,800 to 6,900 feet amsl along the Beaver Rim to 6,200 feet amsl north of the GHPA (**Figure 3.15-3**). This indicates that groundwater in the Wind River Aquifer flows off the Beaver Rim and northwestward from the GHPA and vicinity into the central part of the Wind River Basin, and discharges to the Wind River and its tributaries.

3.15.2.3 Geology of the Mine Units

The GHPA and vicinity contains 4 separate alluvial fan depositional systems in the Wind River Formation, as shown in **Figure 3.3-4** and discussed in Section 3.3.4.1, Uranium, that contain the uranium deposits mined in the area. The uranium to be mined under the Proposed Action is located in the Puddle Springs member of the Wind River Formation, within interbedded sand and shale units. The sands are numbered in even increments of 10 and represent dark gray to greenish-gray arkosic sands with interbedded granite pebble to boulder conglomerates (PRI 2009). The sands are moderately to poorly sorted and locally contain clay and silt fractions as well as clay and siltstone interbeds. The shale units are dark gray to brownish gray and represent zones of fine-grained sandstone, claystone, and mudstone. Contacts between the sand and shale units can be sharp or gradational. Under the Proposed Action, the 30 Sand, 40 Sand, 50 Sand, 60 Sand, 70 Sand, and 80 Sand would be mined in 5 mineable units, which are discussed in more detail in the following subsections.

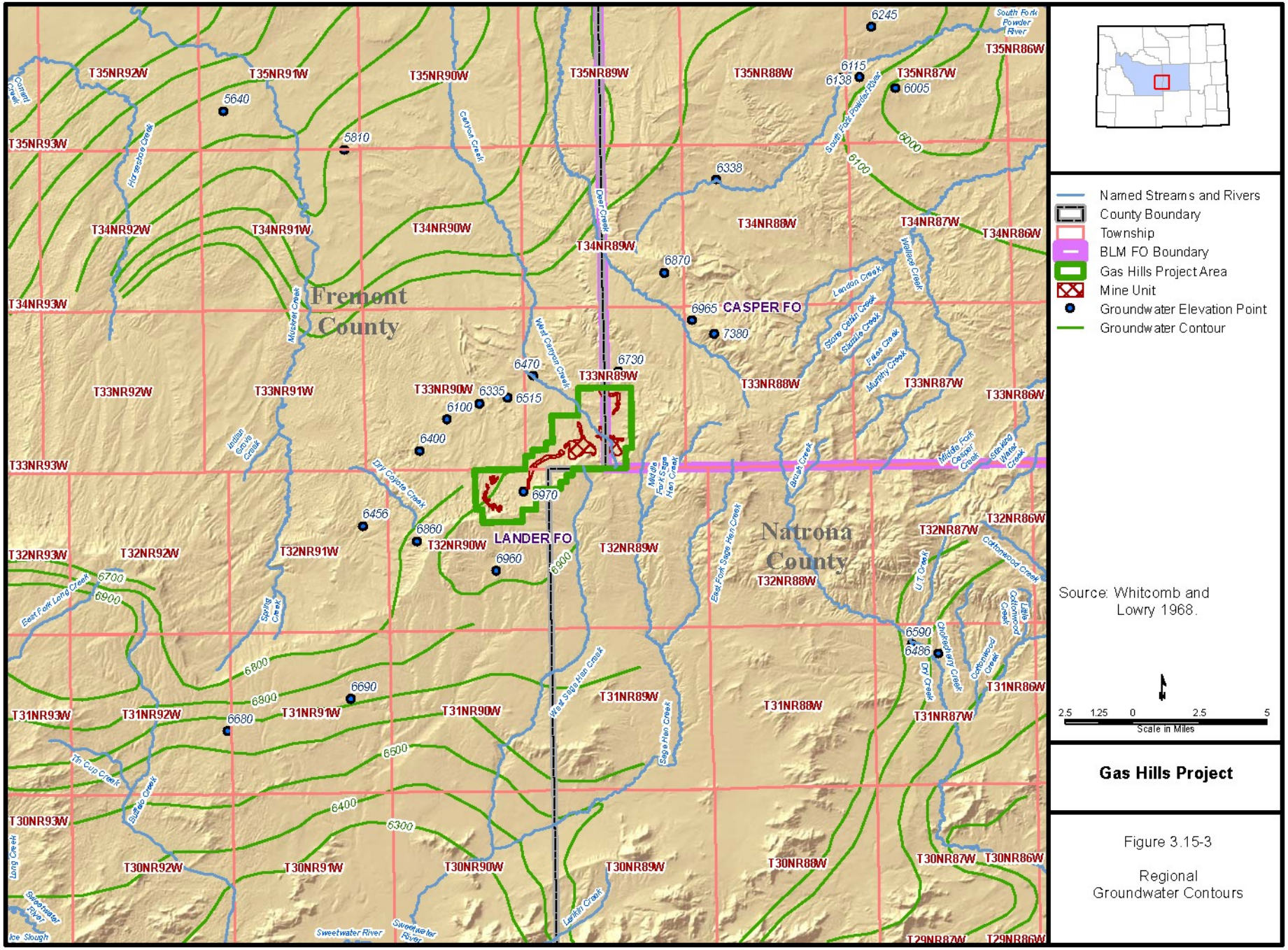
<u>Mine Unit 1 (Muskrat Deposit)</u>

The target for production in this Mine Unit is the 70 Sand, which is part of the Coyote Creek fan system. The ore zone is located in a single sand horizon with no traceable faults in the area (PRI 2009). The ore zone is located in a medium to coarse grained arkosic sand ranging in thickness from 20 to 80 feet. The mineralized sand is confined by an overlying shale unit 55 to 150 feet in thickness and an underlying shale unit 20 to 50 feet in thickness. The 50 Sand lies below the underlying confining shale unit. The 70 Sand is separated from underlying pre-Tertiary units by as much as 200 feet of Wind River Formation (PRI 2009). Two faults, the Jasper Fault and the HBow Fault, are located south of this deposit (**Figure 3.15-4)**. The potentiometric surface (water level or the surface to which groundwater rises in a well that penetrates an aquifer) in the Muskrat Deposit is above the confining shales, making the mineable sand a confined aquifer.

<u>Mine Unit 2 (Bountiful Deposit)</u>

This deposit is located in multiple sands within the Canyon Creek alluvial fan depositional system: (see **Figure 3.3-4**) specifically, the 40, 50, 60, 70, and 80 Sand horizons. The sands are medium to coarse grained arkosic sandstones with cobble to boulder conglomerate interbeds. The individual sands are up to 100 feet in thickness and are separated by shale units 5 to 20 feet thick. The individual shale units separating the mineralized sands are reasonably continuous within the area to be mined but disappear east of the Mine Unit. The upper confining units in Mine Unit 2 consist of siltstones and claystones ranging from 75 to 400 feet in thickness. The lower confining unit, the Triassic Chugwater Formation, is dominantly shale and siltstone in the GHPA (PRI 2009). The mineable sands are part of a confined aquifer system (an aquifer in which the water is under pressure because of an impermeable layer above it that keeps it from seeking its level) with the potentiometric surface above the upper confining shales.

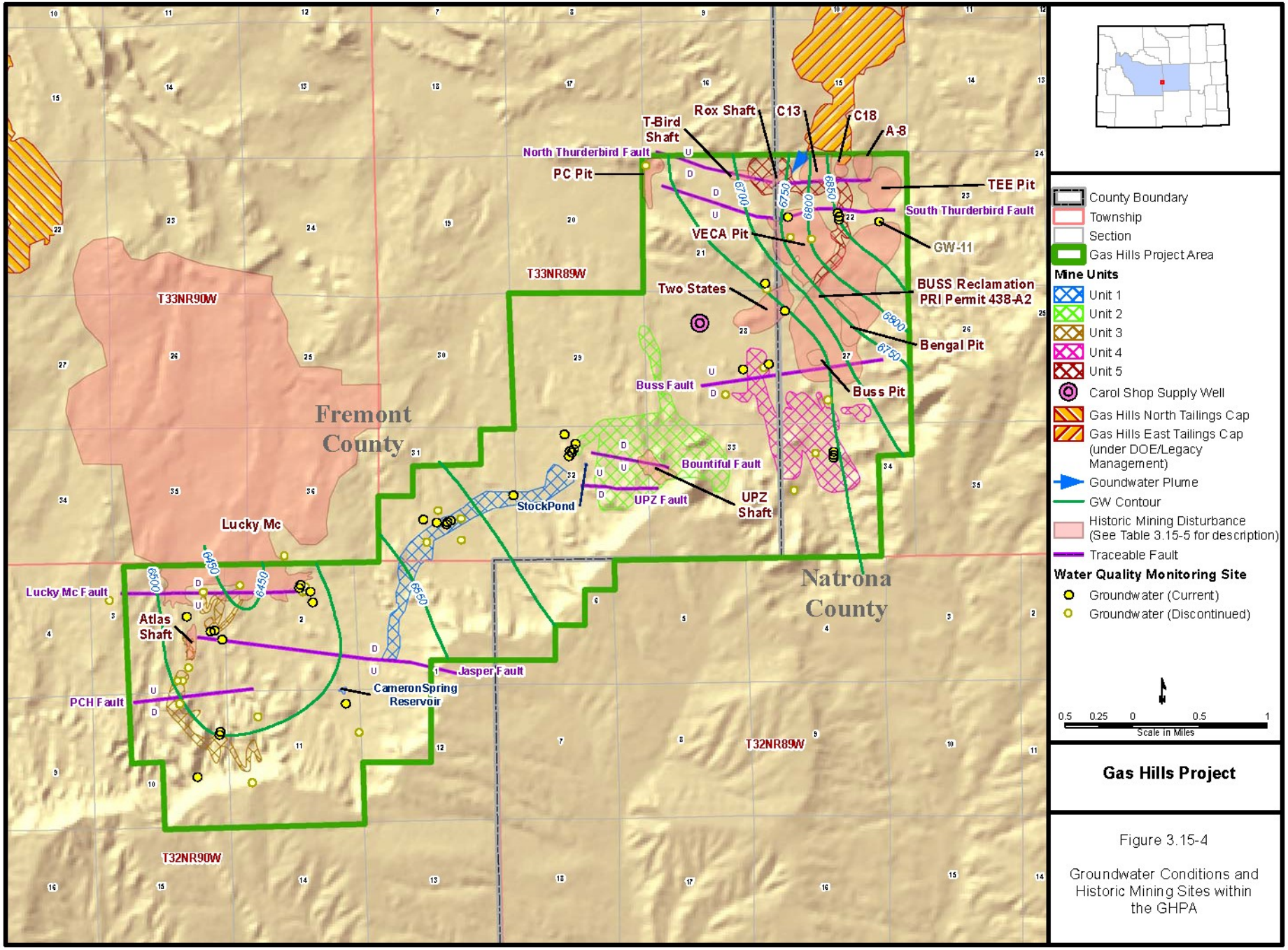
Two traceable faults, the Bountiful Fault and the Uranium Point Zone (UPZ) Fault, are located within this proposed Mine Unit (**Figure 3.15-4)**. The Bountiful Fault has 40 to 50 feet of displacement, while the UPZ Fault has up to 50 feet of displacement and is known to be a groundwater flow path along part of its length (PRI 2009).



Gas Hills Project

Figure 3.15-3

Regional Groundwater Contours



Gas Hills Project

Figure 3.15-4

Groundwater Conditions and Historic Mining Sites within the GHPA

The Bountiful Deposit area has been mined historically. The UPZ shaft is located on the southern edge of this deposit. Construction on this shaft began in 1979 and was halted in 1983 by TVA. In 1983, the shaft was 14 feet in diameter and 880 feet deep with a 1-foot thick concrete liner. Pump stations to dewater the shaft were constructed at 250 and 495 feet below ground surface (bgs) as well as a station and loading pocket located between 742 and 780 feet bgs. The pump stations are 8 feet by 8 feet by 20 feet deep and believed to be cut into siltstone and claystone confining layers (aquitards). The loading pocket and station are approximately 41 feet vertically by 12 feet wide by 40 feet deep connecting the 50 Sand with the 40 Sand (PRI 2009). The shaft was filled with broken concrete in 1991.

Mine Unit 3 (Peach Deposit)

This deposit is located in the western part of the GHPA in the Coyote Creek alluvial fan depositional system (see **Figure 3.3-4**) within multiple sand units. Dewatering of the Lucky Mc pit over the years has lowered the potentiometric surface in the northern part of this Mine Unit (PRI 2009). The Mine Unit contains 2 traceable faults, the PCH and the Jasper faults, and the abandoned Atlas underground mine.

The uranium deposits are located in the 30, 40, 50, and 60 Sands. The Sands are separated by confining claystones and siltstones that can range up to 30 feet thick. The 30 through 70 Sands coalesce along the northwest side of the Mine Unit to form a single sand horizon. The 60 Sand is not currently targeted for mining because of insufficient hydrostatic head, but this may change as groundwater recovers in the Lucky Mc open pit mine (PRI 2009). The upper confining unit is a claystone, 5 to 40 feet thick, that is reasonably continuous over the area to be mined. The lower confining units are either claystones or mudstones of the Wind River Formation, or shales of the pre-Tertiary units. The Morrison, Cloverly, Thermopolis, Muddy, Mowry, and Frontier formations make up the pre-Tertiary units, but only the Cloverly is considered an aquifer and is separated from the production sand by confining units in the Wind River Formation. The potentiometric surface in this Mine Unit is partially within some of the sands, making the aquifer in the sands confined to partially confined.

The Jasper Fault was evaluated with a pumping test in 1996 and shown to have a zone of high transmissivity (groundwater flow) within the Mine Unit. The Lucky Mc Fault, located north of the Mine Unit, may represent a hydrologic barrier. The Atlas underground mine, developed in the 1960s and reclaimed in the 1980s, is located in the western portion of the GHPA and involves the 30, 40, and 50 Sands. The planned injection pattern has been adjusted to exclude the Atlas Mine workings.

Mine Unit 4 (Buss Deposit)

The Mine Unit 4 deposit is located in multiple sand horizons in the eastern part of the GHPA. The partially reclaimed Buss Pit, an historic open pit mine, is located to the northeast and has lowered the potentiometric surface in portions of this Mine Unit. Sands to be mined are the 50 through 80 Sands south of the Buss Fault and the 50, 60, and possibly the 70 Sand north of the fault. The 70 and 80 Sands range in thickness from 30 to 100 feet and are separated by mudstone or siltstone interbeds, and are not always contiguous and frequently disappear allowing for coalescence of the sand units. The uppermost confining unit south of the Buss Fault ranges in thickness from 10 to 100 feet. The confining unit north of the Buss Fault is a shale above the 60 Sand that ranges from 10 to 20 feet in thickness. The 70 and 80 Sands are not confined north of the Buss Fault. The confining unit below the 50 Sand throughout this Mine Unit ranges from 5 to 30 feet in thickness and separates the 50 Sand from the East Canyon Conglomerate (PRI 2009). The potentiometric surface is within the sands north of the Buss Fault, making the aquifer in the sands partially confined to unconfined. South of the Buss Fault the potentiometric surface is above the confining shales, making the aquifer in the sands confined.

Pre-Tertiary formations are not well defined in this Mine Unit due to lack of lithologic logs (also known as a well log) in drill holes that have penetrated the pre-Tertiary (PRI 2009). The lowest sand to be mined, the 50 Sand, rests on a confining unit above the East Canyon Conglomerate or a shale that uncomfortably overlies the Jurassic Sundance Formation.

The Buss Pit mine was partially reclaimed in 1995 and is located northeast of the planned development for this Mine Unit. The Buss Pit Mine extracted ore from the 60, 70, 80, and 90 Sands, and was reclaimed as a reservoir that intersects the local water table. This reservoir is fed by groundwater inflow from the Wind River Aquifer and has affected water quality in this area. The 80 and 90 Sands were mined in pits above the water table. Other open pit mines in the area, such as the Cap, Bengal, and Mars mines, have been backfilled above the water table (PRI 2009).

Mine Unit 5 (Pix Deposit)

The Mine Unit 5 deposit is located within the 50 Sand in the northeastern part of the GHPA. The reclaimed Veca open pit mine, located west of this Mine Unit, is backfilled above the water table. Water quality in the vicinity of the Veca pit has been affected by historic mining. The Thunderbird Mine and Rox Mine is located within the northern part of this Mine Unit. The potentiometric surface lies within the sands in the Pix Deposit, making the aquifer in the sands partially confined to unconfined.

The 50 Sand ranges in thickness from 50 to 70 feet and is a medium to coarse grained arkosic sand. The 60 Sand interfingers with the 50 Sand in the Pix Deposit. The upper confining unit is 15 to 40 feet in thickness while the lower confining unit ranges from 20 to 40 feet in thickness and separates the 50 Sand from the East Canyon Conglomerate. One or more faults marking the southern side of the Thunderbird Graben are located within this Mine Unit.

This Mine Unit is near several historic open pit mines and reclaimed areas within the GHPA (see **Figure 2-1**) as well as an area with capped uranium tailings (Gas Hills East) (PRI 2009). The Rox and Thunderbird underground mines are located within the Thunderbird Graben and were reclaimed in the 1980s. The Pix Deposit is an area of complex faulting and past historic mining. Historic mining operations have resulted in impacts to groundwater within the GHPA, typically, elevated TDS.

3.15.2.4 Hydrogeology of the Mine Units

Groundwater in the GHPA is found mainly within the Wind River Aquifer. Of the overlying units, only the Miocene Split Rock Formation carries water and serves as an aquifer south of the Beaver Rim and outside of the GHPA. The Wagon Bed and White River formations are mostly aquitards in the GHPA (PRI 2009). Geologic units below the Wind River that serve as aquifers are the Cretaceous Cloverly, the Jurassic Nugget, and the Pennsylvanian Tensleep formations. The Cloverly and the Nugget are recharged north of the GHPA in the Dutton Basin Anticline. The main aquitards below the Wind River in the GHPA are the Chugwater and Sundance formations.

Aquifer Characteristics

Within the Wind River Aquifer in the GHPA, the mineralized sands act as local water-bearing units, or local aquifers. With few exceptions, these sands serve as confined aquifers with potentiometric surfaces above the top of the sand. Cameco completed aquifer testing with single well and multi-well pumping tests in the main sand units to be mined (PRI 2009). These pumping tests were run at rates up to 20 to 25 gpm for periods up to about 40 hours. In the Muskrat Deposit, the 70 Sand was tested as well as an overlying non-mineralized sand. In the Bountiful Deposit, the 70 Sand and the underlying 50 Sand were tested along with faults in the area and a confining clay zone. For the Peach Deposit, the 30 Sand and 40 Sand were tested. In the Buss Deposit, the 50 Sand and 60 Sand were tested, and in the Pix Deposit, the 40, 50, and 60 Sands were tested because they can act as 2 aquitards. The results of the aquifer testing are summarized in **Table 3.15-3**.

Aquifer testing also showed that in most of the mineable units, the potentiometric surface in overlying non-mineralized units is higher than the potentiometric surface in the mineable sands, indicating a downward hydraulic gradient. In the Peach Deposit, the 30, 40, and 50 Sands may be hydraulically

Table 3.15-3 Results of Aquifer Testing

Mine Unit	Transmissivity Range ($feet^2$/minute)	Aquifer Thickness Range (feet)	Hydraulic Conductivity Range (feet/minute)
1	5.51×10^{-2} to 1.84×10^{-1}	57 to 65	9.67×10^{-4} to 2.83×10^{-3}
2	3.13×10^{-2} to 2.23×10^{-1}	48	6.52×10^{-4} to 4.65×10^{-3}
3	9.10×10^{-3} to 3.7×10^{-1}	30-170	5.35×10^{-5} to 6.4×10^{-3}
4	1.70×10^{-3} to 2.48×10^{-1}	45 to 287	9.2×10^{-6} to 2.76×10^{-3}
5	4.88×10^{-4} to 5.37×10^{-2}	23-170	2.87×10^{-6} to 7.16×10^{-4}

connected to the 60 and 70 Sands. In the Buss Deposit, the 70 Sand is hydraulically connected to the 80 and 90 Sands and the 50 Sand interfingers with the East Canyon Conglomerate. In the areas where the aquifer thickness is around 100 feet or greater, the 30, 40, 50, and 60 Sands act as a single hydraulic unit. Near faults and near the Buss and Veca pits, aquifer testing is affected by these boundary conditions. In the Peach Deposit, the faults impede or constrict groundwater flow. In the Buss Deposit, leakage from faults or confining units affected the aquifer testing results. In the Pix Deposit, the overlying confining unit showed a response to pumping in the mineralized sands, suggesting hydraulic connection. This was not observed in the other mineable units (PRI 2009).

Groundwater Flow in the GHPA

Groundwater elevations within the mineralized zones in the GHPA suggest groundwater flow from northeast to southwest across the GHPA and approximately parallel to the Beaver Rim. The potentiometric surface ranges from 6,800 feet amsl in the Pix Deposit in the northeast portion of the GHPA to 6,200 feet amsl in the southwestern part of the GHPA. Cameco interpreted this potentiometric gradient to suggest that groundwater flows from northeast to southwest across the GHPA (PRI 2009).

Regional flow in the Wind River Aquifer is south to north with discharge at the Wind River (Whitcomb and Lowry 1968; see **Figure 3.15-3**). When potentiometric levels in the GHPA are compared with those in Whitcomb and Lowry (1968) which show potentiometric levels of 6,200 feet amsl north of the GHPA, then it becomes apparent that groundwater flows to the northwest from the GHPA. Also, groundwater flow in the Wind River Aquifer north of the GHPA discharges to Fraser Draw and WCC. Groundwater flow in the GHPA also is affected by historic mine pits that are refilling with water, such as the Veca Pit and the Buss 1 Pit. Groundwater flows into the pits and evaporates, which causes the pits to act as local groundwater sinks. Historic mine pits that were developed below the water table were subsequently reclaimed by backfilling above the water table, such as the TVA Bengal Pit, the FHP Tee Pit, and the Umetco B2/B3 and C3/C4 Pits (**Figure 3.15-4)**. Groundwater now flows through the pit backfill where it reacts with the oxidized mine spoils used for pit backfill (PRI 2009).

Groundwater Quality

Groundwater quality in the Wind River Aquifer within the GHPA and vicinity varies depending on past historic mining, hydraulic communication between stratigraphic units, and hydraulic interaction between surface and groundwater. **Table 3.15-4** presents the average values for constituents in groundwater by mine unit. Radium concentrations above the Wyoming Class III Standards (5 pCi/L) make this water unsuitable for stock watering.

On a regional basis, groundwater in the GHPA and vicinity is dominated by sulfate due to the presence of gypsum and other secondary sulfate minerals in the sand units. In the eastern part of the GHPA, groundwater is usually dominated by calcium sulfate due to the presence of historic workings and their influence on groundwater quality (PRI 2009). In the western part of the GHPA, with fewer historic mine

Table 3.15-4 Average Concentrations in Background Groundwater by Mining Unit, Upper Wind River Aquifer, Fall 1996-Fall 1997

Constituent	Units	Wyoming Class III Standards	Mine Unit 1	Mine Unit 2	Mine Unit 3	Mine Unit 4	Mine Unit 5
Alkalinity	mg/L	--[e]	231	245	172	184	187
Ammonium	mg/L	--[e]	0.2	0.2	0.3	0.1	0.1
Bicarbonate	mg/L	--[e]	282	293	197	225	228
Calcium	mg/L[a]	--[e]	69	69	64	129	408
Carbonate	mg/L	--[e]	0.1	3.8	5.1	0.1	0.1
Chloride	mg/L	2,000	18	11	20	7	61
Conductivity	µmhos/cm[b]	--[e]	943	881	1,278	879	2,088
Fluoride	mg/L	--[e]	1	1.1	0.8	1	1
Magnesium	mg/L	--[e]	15	13	14	25	74
Manganese	mg/L	--[e]	0.06	0.1	0.02	0.07	0.4
Potassium	mg/L	--[e]	16	12	16	17	26
Radium	pCi/L[d]	5	705	114	136	304	65
Ore Zone Radium[f]	pCi/L	5	1,277	136	434	939	333
Silica	mg/L	--[e]	17	17	13	34	21
Sodium	mg/L	--[e]	116	114	194	31	40
Sulfate	mg/L	3,000	236	219	451	298	1,102
Uranium	mg/L	--[f]	0.01	0.05	0.04	0.01	0.09
Ore Zone Uranium[f]	mg/L	--[f]	0.02	0.06	0.11	0.01	0.01
Zinc	mg/L	25	0.01	0.01	0.01	0.01	0.02
pH	s.u.[c]	6.5-8.5	8.1	8.1	8.4	7.9	7.7
TDS	mg/L	5,000	623	573	863	660	1,887

[a] Milligrams per liter.

[b] Micro-ohms per centimeter.

[c] Standard units.

[d] Picocuries per liter.

[e] No standard.

[f] The standard is in pCi/L; no direct comparison to mg/L.

Source: Table D6-33 in PRI 2009; WDEQ-LQD 2005a (Standards, Guideline 8).

workings, the groundwater tends to be sodium bicarbonate-sulfate water. In areas where water infiltrating through overlying geologic units has affected groundwater quality in the Wind River Formation, the water tends to be dominated by bicarbonate. WCC, for example, has calcium bicarbonate water and Cameron Spring has water dominated by sodium bicarbonate that is derived from the Wagon Bed

Formation (PRI 2009). Groundwater in the GHPA and vicinity is generally within the Wyoming Class III water standards, except for radionuclides. Historic mine workings that affect groundwater quality are summarized in **Table 3.15-5**.

Within the GHPA, the Muskrat Deposit and Bountiful Deposit are the least affected by historic mine workings and show groundwater dominated by bicarbonate with elevated sulfate that is approximately equal to bicarbonate. Sodium concentrations are greater than calcium, making the groundwater sodium bicarbonate – sulfate water. Background groundwater quality ranges for TDS, uranium, and radium are provided below:

- The TDS is in the range of 500 to 700 mg/L;
- Background uranium ranges from 0.01 to 0.05 mg/L; and
- Background radium ranges from 114 to 705 pCi/L.

The Peach Deposit has sulfate greater than bicarbonate and sodium greater than calcium, making the groundwater sodium sulfate water. TDS has an average value of 863 mg/L, reflecting the increase in sulfate. The Buss Deposit and the Pix Deposit have calcium sulfate water. Background groundwater quality ranges for TDS, pH, and uranium are provided below:

- The TDS values range from 660 mg/L and 1,887 mg/L, respectively;
- The pH values in Mine Units 4 and 5 is below 8.0 s.u., while the pH in Mine Units 1, 2, and 3 is above 8.0 s.u.; and
- Background uranium in the Pix Deposit is 0.09 mg/L, which is higher by a factor of 2 compared to other deposits.

In general, radium concentrations in groundwater are higher in the southwestern part of the GHPA and uranium concentrations in groundwater are higher in the northeastern part of the GHPA. TDS and calcium decrease from west to east across the GHPA, while sodium and bicarbonate increase from west to east (PRI 2009).

Mine Unit 5 shows the effect of reclaimed historic pits that are currently acting as flow-through pits and altering the chemistry of the groundwater. This has been demonstrated by monitoring well GW-11. Sampling of this well in 1981 and 1982 showed a calcium sulfate water with TDS ranging from 508 to 532 mg/L and sulfate in the range of 276 to 308 mg/L. Sampling of this well in 1996 and 1997 by Cameco showed TDS values ranging from 1,350 to 1,450 mg/L and sulfate in the range of 650 to 741 mg/L, suggesting contamination of groundwater in the Wind River Aquifer by historic workings in the vicinity of Mine Unit 5 (PRI 2009).

Mine Unit 4 may have evidence of mixing of surface and groundwater, or mixing of deep and shallow groundwater. Characterizations of the sands in the vicinity of the Mine Unit suggests a mixing of deep sulfate waters from geologic units such as the East Canyon Conglomerate, or the 40, 50, 60, and 70 Sands, with bicarbonate dominated surface water or water from shallow parts of the Wind River Aquifer. This intercommunication between aquifer units or groundwater and surface water may be due to movement of water along the Buss Fault or hydraulic intercommunication between sand units (PRI 2009).

Cameron Spring is an upgradient spring in the Wagon Bed Formation that has not been affected by historic mining. Groundwater from Cameron Spring is calcium bicarbonate water with a TDS in the range of 252 to 491 mg/L. The water is sodium bicarbonate water with bicarbonate in the range of 212 to 369 mg/L and sodium ranging from 69 to 131 mg/L. The pH is 7.6 to 9.8 s.u. Uranium has a maximum value of 0.028 mg/L and radium has a maximum of 0.8 pCi/L (PRI 2009).

Table 3.15-5 Historic Workings Table

Name	Location	Name of Disturbance	Status of Disturbance
UPZ Shaft	Mine Unit 2	Underground Mine Shaft	Reclaimed 1991, TVA Permit #438
Pathfinder Lucky Mc Area 4 Pit and Spoils	North of Mine Unit 3	Pit Open to Water Table, and Associated Spoils	Reclaimed as Groundwater-Fed Impoundment by Pathfinder, Permit 356C
Atlas Mine Workings	Mine Unit 3	Underground Mine Workings Approximate Bottom Elevation 6,400 feet	Surface Reclamation, 1989, AML Project 16C
Buss Pit and Spoils	Northeast of Mine Unit 4	Buss I, II, III, and Cap Pits and Associated Spoils	Reclaimed as Groundwater-Fed Impoundment, 1995 by PRI, Permit 438
Bengal Pit and Spoils	Northeast of MU 4	Open Pit and Associated Spoils	Reclaimed as Backfill, 1988-1991 by TVA, Permit 438
Two States Pit and Spoils	North of Mine Unit 4	Open Pit and Underground Workings, Bottom Elevation 6,670 to 6,700 feet Above Water Table	Future AML Project 161
Veca Pit and Spoils	South and West of MU 5	Open Pit and Associated Spoils	Reclaimed as Surface Water Impoundment, 1989, AML Project 16D
Tee Pit	East of Mine Unit 5	Open Pit and Spoils	Backfilled, Reclaimed 1989, AML Project 16E
A-8	Northeast of Mine Unit 5	Open Pit and Spoils, Underground Workings	Backfilled, Reclaimed 1989, AML Project 16E
C-13	Northeast of Mine Unit 5	Open Pit and Spoils	Backfilled, Reclaimed Pre 1988 by Umetco, Permit 349C
C-18	North of Mine Unit 5	Open Pit and Associated Spoils	Future AML Project
Rox Shaft	West of Mine Unit 5	Underground Mine Workings, Ion-Exchange Facility	Surface Reclamation, 1989, AML Project 16C
Thunderbird Shaft	West of Mine Unit 5	Underground Mine Workings	Surface Reclamation, 1989, AML Project 16C
PC Pit	West of Mine Unit 5	Open Pit and Spoils	Reclaimed Ground Water-Fed Impoundment, 1991, AML Project 16F

Locations of Disturbances Shown on Plates D6-1 and D6-3 of the WDEQ application (PRI 2009).

Sampling of historic pits by Cameco has shown that water in the Veca Pit has elevated uranium and radium (PRI 2009). The water is dominated by calcium sulfate. The PC Pit has elevated uranium and radium. The water is calcium-magnesium–sodium sulfate water. The water in Buss 1 Pit Lake is calcium sulfate dominated. Additional water quality sampling data for the pits and monitoring wells near the Veca Pit are provided in **Table 3.15-6**.

Table 3.15-6 Water Quality Within Historic Pits

Monitoring Location	Low Range	High Range
Veca Pit		
TDS	614 mg/L	1,190 mg/L
Sulfate	344 mg/L	808 mg/L
Bicarbonate	<100 mg/L	---
pH	7.6	7.9
Monitoring Wells near Veca Pit		
TDS	2,660 mg/L	2,710 mg/L
Sulfate	1,410 mg/L	1,641 mg/L
Calcium	505 mg/L	580 mg/L
Selenium	0.08 mg/L	0.097 mg/L
Uranium	0.05 mg/L	0.09 mg/L
Radium	---	22.2 pCi/L
PC Pit		
TDS	1,280 mg/L	2,940 mg/L
Sulfate	1,750 mg/L	1,980 mg/L
pH	7.6	7.9
Buss Pit		
TDS	2,540 mg/L	3,080 mg/L
Sulfate	1,678 mg/L	2,100 mg/L
Selenium		0.01 mg/L
Uranium	---	0.11 mg/L
Radium	1.8 pCi/L	3.7 pCi/L

Source: PRI 2009.

In addition to groundwater quality impacts from historic mining activities, groundwater quality in the GHPA has been impacted by past milling activities to the north of Mine Unit 5. As discussed in Section 2.1.2.1, Historic Mining, an area with historic uranium mill tailings has been reclaimed and capped (Gas Hills East). Seepage from these tailings continues to impact groundwater (DOE 2010) including a plume of elevated metals and radionuclides that extends about 1,000 feet southwest of the cap (**Figure 3.15-4)**. Mine Unit 5 currently lies on the leading edge of this contaminant plume which is moving at an average rate of 36 feet per year (maximum flow rate of 102 feet per year; DOE 2010). The

distance across Mine Unit 5 along the flow path of the southwest flow system is about 1,000 feet, suggesting that over the next 27 years, the plume may be located within Mine Unit 5.

In summary, groundwater quality in portions of the GHPA is affected by the presence of historic workings and the effects of past mining and milling activities on groundwater. Reclaimed pits are acting as flow-through pits, and allow groundwater quality to be altered by reaction with mine spoils used for pit backfill. Faults allow communication of groundwater between sand units in the Wind River Aquifer. Overlying geologic units may contribute infiltrating water to the sand units and increase the bicarbonate content. Also, there may be local areas where surface and groundwater interact, especially in faulted areas. Each mine unit in the GHPA has a distinctive signature to groundwater quality that reflects the mineralogy of the sand units, geologic structures, and hydraulic communication between sand aquifers and past mining history.

3.15.3 Water Use

Water use is administered by the Wyoming State Engineer's Office (WSEO). **Table 3.15-7** tabulates the water rights (for both surface water and groundwater) within 10 miles of the GHPA. Locations of these wells are shown in **Figure 3.15-5**. Water rights with a Certificate Record book/page number below the permit number are an adjudicated, or finalized, water right. No public water supply wells or intakes are within the GHPA. Currently permitted water use in the GHPA is limited to livestock and wildlife watering, and miscellaneous uses which are related to the mining activity in the area, including water supply at the Carol Shop facility. The majority of the water right permits within the GHPA are held by PRI, with several by BLM, and 1 each by Umetco Minerals Corporation and Matador Cattle Company. The water permits identified as reservoirs are located in depressions left by previous mine operations that have filled with water.

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P181094.0W	Carlson Grant	Meeks Ridge L2B4	205	DOM_GW	T13N	R117W	S25	SE¼SW¼
P11378.0W	USDOI - BLM	Barlow Well #4103	100	STK	T31N	R88W	S6	SE¼NW¼
P63385.0W	USDOI - BLM	West Diamond Project #4548	290	STK	T31N	R90W	S8	SW¼SW¼
P63386.0W	USDOI - BLM	Agate Butte Project #4550	235	STK	T31N	R90W	S14	NW¼NW¼
P77596.0W	Baker, DVM James D./ USDOI - BLM	West Diamond Well #2	340	STK	T31N	R91W	S12	NW¼NE¼
P64313.0W	USDOI - BLM	Beaver Rim #5093	280	STK	T31N	R91W	S9	NW¼NE¼
P179702.0W	Lola James R. and Angela M.	Wet 2	176	DOM_GW	T32N	R72W	S24	NW¼NW¼
P107493.0W	Street Jerry & Judy	Street Spring #2	1	STK	T32N	R87W	S06	NE¼SW¼
P62782.0W	France Joe	F 2	435	STK	T32N	R88W	S04	NW¼NE¼
P62783.0W	France Joe	F 33	278	STK	T32N	R88W	S22	SW¼NE¼
P62824.0W	USDOI - BLM/France Joe	33-6	271	STK	T32N	R88W	S27	NW¼NW¼
P3021.0W	France Eva l.	Circle Bar #1	120	DOM_GW	T32N	R88W	S22	NE¼SE¼
P46376.0W	Matador Cattle Co.	Sage Hen #4	5	STK	T32N	R89W	S13	NW¼NE¼
P46377.0W	Matador Cattle Co.	Sage Hen #3	2	STK	T32N	R89W	S15	NE¼NW¼
P49333.0W	Matador Cattle Co.	Barrel Springs #1	4	STK	T32N	R89W	S08	SW¼SW¼
P34024.0W	Pathfinder Mines Corp.	GR-1	193	MIS	T32N	R90W	S07	NW¼NW¼
P44457.0W [a]	Matador Cattle Co.	Cameron Springs #1	4	STK	T32N	R90W	S11	NE¼NE¼
P45504.0W	USDOI - BLM	West Diamond #2	0	STK	T32N	R90W	S28	SE¼NW¼
P46382.0W	Matador Cattle Co.	Wild Horse #1	4	STK	T32N	R90W	S18	SE¼SE¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P47062.0W	Pathfinder Mines Corp	West Gas Hill Mine Sump	350	IND_GW; MIS	T32N	R90W	S07	NE¼NW¼
P49123.0W	Matador Cattle Co.	Wild Horse #2	85	STK	T32N	R90W	S18	SE¼SE¼
P93946.0W	USDOI - BLM	PWR #107 Spring(178)	-1	STK	T32N	R90W	S07	NW¼SE¼
P38624.0W	American Nuclear Corp.	Peach #6	460	MIS	T32N	R90W	S03	SE¼SE¼
P102706.0W	Mcintosh Jennifer Ann/ Joe E.	32-32-91	120	STK	T32N	R91W	S32	SE¼SE¼
P105282.0W	USDOI - BLM	Day Loma Pit Well #1	225	MIS	T32N	R91W	S24	NW¼SE¼
P46383.0W	Matador Cattle Co.	Mud Springs #1	4	STK	T32N	R91W	S26	NW¼SW¼
P49124.0W	Matador Cattle Co.	Coyote Springs #2	190	STK	T32N	R91W	S13	NW¼NE¼
P50224.0W	The Matador Cattle Company/Wyoming State Office of Lands & Investments	Adams #1	400	STK	T32N	R91W	S36	NE¼SE¼
P93756.0W	USDOI – BLM	Mud Spring	-1	STK	T32N	R91W	S26	SE¼SW¼
P93895.0W	USDOI – BLM	No Name Spring #17	-1	STK	T32N	R91W	S26	SE¼SW¼
P176489.0W	Hancock William and Ada	Sherlock #1	60	STK	T32N	R91W	S09	SW¼SW¼
P169222.0W	USDOI - BLM/Clark Mike	S Muskrat Well Section 13	0	STK	T32N	R92W	S13	NE¼NE¼
P129109.0W	Backus Jay	Six Mile #1	60	DOM_GW; STK	T33N	R87W	S06	SE¼SE¼
P171548.0W	Garnier III Ira J.	Garnier #5	2	DOM_GW; STK	T33N	R87W	S31	NW¼SW¼
P22948.0P	USDOI - BLM	Murphy Creek Well #1	1,130	STK	T33N	R87W	S20	SW¼SE¼
P71756.0W	Clear Creek Cattle Co.	Lesmeister Spring	5	STK	T33N	R88W	S23	SW¼SW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P71757.0W	Clear Creek Cattle Co.	Little Cross L #1 Spring	4	STK	T33N	R88W	S06	NW¼SW¼
P71759.0W	Clear Creek Cattle Co.	French Rocks #1 West	5	STK	T33N	R88W	S09	SE¼SW¼
P71761.0W	Clear Creek Cattle Co.	East Slope #1	5	STK	T33N	R88W	S04	NE¼NW¼
P71763.0W	Stroecker Anna	Stroecker Spring	5	STK	T33N	R88W	S15	SE¼SW¼
P71764.0W	USDOI - BLM/Clear Creek Cattle Co.	Government #1 West (Rattlesnake)	5	STK	T33N	R88W	S06	SE¼ SE¼
P71765.0W	USDOI - BLM/Clear Creek Cattle Co.	Government #2 East (Rattlesnake)	4	STK	T33N	R88W	S15	NW¼ NE¼
P37858.0W	Allison Velda	Allison #4	20	DOM_GW	T33N	R88W	S22	NW¼SW¼
P44796.0W	Matador Cattle Co.	Rattlesnake #1	2	STK	T33N	R88W	S07	NE¼NE¼
P44797.0W	Matador Cattle Co.	Rattlesnake #2	4	STK	T33N	R88W	S08	SE¼ NE¼
P44799.0W	Matador Cattle Co.	Rattlesnake #4	5	STK	T33N	R88W	S08	SW¼SW¼
P44801.0W	Matador Cattle Co.	Rattlesnake #6	4	STK	T33N	R88W	S23	NW¼ SE¼
P44802.0W	Matador Cattle Co.	Rattlesnake #7	-4	STK	T33N	R88W	S27	NE¼ NE¼
P46384.0W	Matador Cattle Co.	Holiday #1	5	STK	T33N	R88W	S19	SW¼SW¼
P46387.0W	Matador Cattle Co.	Little X-L #1	2	STK	T33N	R88W	S06	NW¼SW¼
P94133.0W	USDOI - BLM	Upper Mac Spring	-1	STK	T33N	R88W	S30	NW¼NW¼
P94134.0W	USDOI - BLM	Spring #7	-1	STK	T33N	R88W	S19	NW¼SW¼
P22949.0P	USDOI - BLM	Six Mile Well #1	708	STK	T33N	R88W	S12	SE¼NW¼
P196585.0W	Backus Jay	Backus #10	0	DOM_GW; STK	T33N	R88W	S10	NE¼NE¼
P94135.0W	USDOI - BLM	Spring #8	-1	STK	T33N	R88W	S19	SW¼SW¼
P71760.0W	Clear Creek Cattle Co.	French Rocks #2 East	4	STK	T33N	R88W	S15	NW¼SW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P44800.0W	Matador Cattle Co.	Rattlesnake #5	3	STK	T33N	R88W	S17	NE¼NE¼
P71758.0W	Clear Creek Cattle Co.	Mckenzie Spring	5	STK	T33N	R88W	S19	SW¼SW¼
P44795.0W	Matador Cattle Co.	Mckenzie Bogs #1	4	STK	T33N	R88W	S26	NW¼NE¼
P71768.0W	Clear Creek Cattle Co.	Lybyer #1	3	STK	T33N	R88W	S15	NW¼SW¼
P71755.0W	Clear Creek Cattle Co.	Cross L #2 Spring	3	DOM_GW; STK	T33N	R88W	S07	NW¼NE¼
P44798.0W	Matador Cattle Co.	Rattlesnake #3	5	STK	T33N	R88W	S08	SW¼NE¼
P102340.0W	USDOI - BLM/Union Carbide Corp.	Guard Well 3b	0	IND_GW; MIS	T33N	R89W	S04	NE¼SE¼
P67075.0W	USDOI - BLM/Clear Creek Cattle Co.	Beaver Rim #2	159	STK	T33N	R89W	S15	SE¼SW¼
P71766.0W	Umetco Minerals Corp.	MWC-34	10	MIS	T33N	R89W	S27	NE¼NE¼
P82563.0W	Umetco Minerals Corp.	MWC-35	200	MIS	T33N	R89W	S15	NE¼NW¼
P82564.0W	Umetco Minerals Corp.	MWC-36	190	MIS	T33N	R89W	S10	SE¼SW¼
P82565.0W	Umetco Minerals Corp.	MWC-42	200	MIS	T33N	R89W	S10	SE¼SW¼
P83269.0W	Umetco Minerals Corp.	MWC-45	240	MIS	T33N	R89W	S10	SE¼SW¼
P84751.0W	Umetco Minerals Corp.	MWC-47	240	MIS	T33N	R89W	S15	NW¼NE¼
P84753.0W	Umetco Minerals Corp	MWC-48	255	MIS	T33N	R89W	S15	NW¼NE¼
P84754.0W	Umetco Minerals Corp	ENL MWC-42	245	MIS	T33N	R89W	S15	NW¼NE¼
P85776.0W	Matador Cattle Co.	COLE #80	240	STK	T33N	R89W	S10	NE¼SW¼
P46385.0W	Matador Cattle Co.	Medicine Springs #1	2	STK	T33N	R89W	S18	SW¼NE¼
P46388.0W	Matador Cattle Co.	Iron Spring #1	6	STK	T33N	R89W	S07	NW¼NW¼
P46389.0W	Matador Cattle Co.	Lincoln Springs #1	3	STK	T33N	R89W	S08	SE¼SW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P49121.0W	Umetco Minerals Corp.	MWC 55	5	MIS	T33N	R89W	S07	SE¼NE¼
P91277.0W	Umetco Minerals Corp.	MWC 57	171.78	MIS	T33N	R89W	S10	NE¼SE¼
P91279.0W	Umetco Minerals Corp.	MWC 59	252	MIS	T33N	R89W	S15	NE¼NW¼
P91281.0W	Umetco Minerals Corp.	MWC 60	250	MIS	T33N	R89W	S10	SE¼SW¼
P91282.0W	Umetco Minerals Corp.	MWC 62	160	MIS	T33N	R89W	S15	SE¼SW¼
P91284.0W	USDOI - BLM	PWR #107 Spring (77)	165	STK	T33N	R89W	S15	SE¼SW¼
P93801.0W	USDOI - BLM/Power Resources, Inc	Gas Hills Water Well-1	-1	MIS	T33N	R89W	S18	NE¼SW¼
P9573R CR15/76 [a]	BLM	Veca Pond Reservoir	N/A	Stock Water; Wildlife	T33N	R89W	S22	NW¼SW¼
P10039R CR 15/77 [a]	PRI	Buss I Reservoir	N/A	Stock Water	T33N	R89W	S27	SW¼NW¼
P10040R CR15/78 [a]	PRI	Buss III Reservoir	N/A	Stock Water	T33N	R89W	S27	NE¼SW¼
P10041R CR15/79 [a]	PRI	Cap Pit Reservoir	N/A	Stock Water	T33N	R89W	S27	NW¼NE¼
P95290W CR10/404 [a]	PRI	Buss I Reservoir Well	171	Misc. (Reservoir Supply)	T33N	R89W	S27	SE¼NW¼
P71766W [a]	BLM	Beaver Rim #2 Well	-4	Stock Water	T33N	R89W	S27	NE¼NE¼
P44612W [a]	PRI	Carol Well #1	200	Misc. (Drinking Water, Sanitary Purposes, General Clean-up)	T33N	R89W	S28	NE¼SW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P184398W [a]	PRI	Carol Well #1	N/A	Misc. (Oil & Gas Well Drilling, Potable & Sanitary Supply)	T33N	R89W	S28	NE¼SW¼
P104718W [a]	Umetco Minerals Corp.	C-18 Pit Well	80	Misc. (Pit Dewatering)	T33N	R89W	S22	NE¼NW¼
P179593W [a]	PRI	Gas Hills Water Well-1	N/A	Misc.	T33N	R89W	S32	SE¼NW¼
P179593.0W	Umetco Minerals Corp.	Process Water Well #6	0	IND_GW; MIS	T33N	R89W	S32	SE¼NW¼
P162305.0W	USDOI - BLM/Highland Uranium Project Power Resources Inc.	Buss I Reservoir	1,685	MIS	T33N	R89W	S18	NE¼SW¼
P95290.0W	Umetco Minerals Corp.	MWC 56	210	MIS	T33N	R89W	S27	SE¼NW¼
P91278.0W	Umetco Minerals Corp.	MWC-49	261	MIS	T33N	R89W	S15	NE¼NW¼
P84755.0W	USDOI - BLM/Clear Creek Cattle Co.	Cross Meadows 12-1	240	STK	T33N	R89W	S15	NW¼NE¼
P182674.0W	Umetco Minerals Corp. NW	MWC-33	0	MIS	T33N	R89W	S12	SW¼SW¼
P82562.0W	USDOI - LM/Union Carbide Corp.	Guard Well 3c	210	IND_GW; MIS	T33N	R89W	S15	NE¼NW¼
P67076.0W	Matador Cattle Company	Sage Hen #1	159	STK	T33N	R89W	S15	SE¼SW¼
P46378.0W	Umetco Minerals Corp	MWC 61	5	MIS	T33N	R89W	S26	SE¼SE¼
P91283.0W	Umetco Minerals Corp	MWC 58	150	MIS	T33N	R89W	S15	SE¼SW¼
P91280.0W	BLM/Power Resources	Carol Well # 1	250	MIS; MIS	T33N	R89W	S10	SE¼SW¼
P184398.0W	USDOI-BLM/Umetco Minerals Corp.	Aljob #2	400	MIS	T33N	R89W	S28	NE¼SW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P104730.0W	USDOI-BLM/Union Carbide Corp.	Guard Well 3B	537	IND_GW; MIS	T33N	R89W	S15	SE¼NE¼
P27451.0W	USDOI, BLM/Umetco Minerals Corp	Dick #1	355	MIS	T33N	R90W	S31	NE¼SE¼
P682.0G	Pathfinder Mines Corp.	Lucky Mc #5	995	DOM_GW; IND_GW	T33N	R90W	S23	NE¼SW¼
P710.0G	Federal Uranium Corp	SAGEBRUSH #1 ON CLAIM SAGEBRUSH #4	180	DOM_GW	T33N	R90W	S32	NE¼NE¼
P782.0G	Federal American Partners	Federal Water #1	371	MIS	T33N	R90W	S33	NW¼NW¼
P438.0G	Pathfinder Mines Corp.	Lucky Mc 1	90	DOM_GW	T33N	R90W	S23	NW¼SE¼
P46386.0W	Matador Cattle Co.	Clay Ruins #1	3	STK	T33N	R90W	S28	NE¼NE¼
P46768.0W	Federal American Partners	George 1	140	MIS	T33N	R90W	S27	NE¼NE¼
P47061.0W	Pathfinder Mines Corp	ENL Lucky Mc #11	2,140	IND_GW; MIS	T33N	R90W	S22	NW¼SW¼
P87214.0W	Pathfinder Mines Corp	Area 4 Reclamation Reservoir	460	MIS	T33N	R90W	S35	SE¼SE¼
P87215.0W	Pathfinder Mines Corp	Area 5 Reclamation Reservoir	250	MIS	T33N	R90W	S26	SE¼NW¼
P501.0G	Pathfinder Mines Corp.	Lucky Mc #3	218	DOM_GW; IND_GW	T33N	R90W	S26	SW¼NW¼
P502.0G	Pathfinder Mines Corp.	Lucky Mc #4	112	DOM_GW; IND_GW	T33N	R90W	S22	SE¼SE¼
P89649.0W	USDOI - BLM	Willow Springs Well	190	STK	T33N	R90W	S34	SW¼SW¼
P557.0W	Ormsbee Development Co.	MIMAR #1	110	MUN_GW	T33N	R90W	S28	NE¼SW¼
P558.0W	Ormsbee Development Co.	MIMAR #2	110	MUN_GW	T33N	R90W	S28	SE¼NW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P559.0W	Ormsbee Development Co.	MIMAR #3	110	MUN_GW	T33N	R90W	S28	SE¼NW¼
P148078.0W	Dick Dean D./Teresa A.	Dick #1	60	DOM_GW	T33N	R90W	S03	SW¼NE¼
P149399.0W	USDOI – BLM	Sagebrush/ Tablestakes Pit	28	MIS	T33N	R90W	S32	SW¼NE¼
P175221.0W	BRS INC.	Gunnel #1	1,495	MIS	T33N	R90W	S25	NE¼NW¼
P183419.0W	Woming State Board of Land Commissioners/ USDOI - BLM/Barnhart Drilling Co., Inc.	Lucky Mc #12	1,451	MIS	T33N	R90W	S24	SE¼NW¼
P182956.0W	USDOI - BLM/Wyoming State Board Of Land Commissioners/ Barnhart Drilling Co., Inc.	Lucky Mc14	1,505	MIS	T33N	R90W	S24	NE¼SW¼
P439.0G	Pathfinder Mines Corp.	Lucky Mc 2	110	DOM_GW	T33N	R90W	S26	NE¼NW¼
P47060.0W	Pathfinder Mines Corp.	ENL Lucky Mc #8	1,500	IND_GW; MIS	T33N	R90W	S22	NE¼SE¼
P716.0G	Pathfinder Mines Corp.	Lucky Mc #6	1,340	DOM_GW; IND_GW	T33N	R90W	S23	SW¼NW¼
P717.0G	Pathfinder Mines Corp.	Lucky Mc #7	1,720	DOM_GW; IND_GW	T33N	R90W	S22	NE¼NE¼
P100564.0W	Hancock Bill/Ada	Musk Rat #1	100	DOM_GW; STK	T33N	R91W	S02	NW ¼SW¼
P24156.0P	Matador Cattle Co.	Puddle Springs #17-1	150	STK	T33N	R91W	S25	NE¼SE¼
P24179.0P	Matador Cattle Co.	Puddle Springs #17-3	175	DOM_GW; STK	T33N	R91W	S24	SE¼SE¼
P119032.0W	Wyoming State Board of Land Commissioners/ Hancock William/Ada	Ohio #1	115	STK	T33N	R91W	S16	SW¼SW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P127731.0W	Hancock William/Ada	Hancock #1	60	STK	T33N	R91W	S34	NW¼NW¼
P130612.0W	Hancock William/Ada	Hancock No. 2	140	STK	T33N	R91W	S27	NW¼SE¼
P130613.0W	Hancock William/Ada	Hancock No. 3	60	STK	T33N	R91W	S10	NW¼SE¼
P89712.0W	USDOI - BLM	Pipeline Well	43	STK	T33N	R91W	S11	SW¼NE¼
P5286.0P	Grieve Land & Cattle Co.	Muskrat #1	50	DOM_GW; STK	T33N	R91W	S03	NE¼SE¼
P44529.0W	Matador Cattle Co.	Puddle Springs 1	6	STK	T33N	R91W	S25	NW¼NE¼
P146970.0W	Herbst Lois G.	#1	170	MIS	T34N	R88W	S08	SW¼SW¼
P24150.0P	Matador Cattle Co.	Ervay Basin #12-4	150	STK	T34N	R88W	S08	SW¼NW¼
P24155.0P	Matador Cattle Co.	Ervay Basin #12-2	450	STK	T34N	R88W	S28	NE¼SE¼
P24173.0P	Matador Cattle Co.	Mcrae Gap #13-1	50	STK	T34N	R88W	S26	NW¼NE¼
P71762.0W	Clear Creek Cattle Co.	Roberts Spring	5	STK	T34N	R88W	S31	NW¼NE¼
P71821.0W	Clear Creek Cattle Co.	Waterworks Well	160	MIS	T34N	R88W	S26	NW¼NE¼
P191436.0W	Herbst Lazy Ty Ranch, LLP	Ervay Basin No. 3	450	STK	T34N	R88W	S19	NE¼NW¼
P85633.0W	Clear Creek Cattle Co.	ENL Waterworks Well	160	MIS	T34N	R88W	S26	NW¼NE¼
P24154.0P	Matador Cattle Co.	Ervay Basin #12-1	145	STK	T34N	R88W	S21	SE¼NE¼
P24172.0P	Matador Cattle Co.	JE Ranch #12-5	175	DOM_GW; STK	T34N	R88W	S32	NE¼NW¼
P2662.0W	Miles Nellie K./ Miles James N.	miles #6	92	STK	T34N	R89W	S05	NE¼NW¼
P79467.0W	M 3 Industries	M3 #1	140	MIS; STK	T34N	R89W	S01	SW¼NE¼
P96884.0W	Herbst Lazy Ty Land Co.	Herbst Ervay Basin #1	75	STK	T34N	R89W	S23	SW¼SW¼
P98996.0W	Herbst Lazy Ty Land Co.	Herbst Ervay Basin #2	3,378	STK	T34N	R89W	S23	NE¼SW¼

Table 3.15-7 Water Rights Within 10 Miles of the GHPA

Water Right	Applicant	Facility Name	Well Depth (feet bgs)	Uses	Location Legal No. Description			
P18297.0P	Miles James N./ Miles Nellie K.	Miles #7	132	STK	T34N	R89W	S09	NE¼NW¼
P24149.0P	Matador Cattle Co.	Ervay Basin #12-3	160	STK	T34N	R89W	S13	SE¼SW¼
P174546.0W	Burgett Glenn	Burgett #1	55	STK	T34N	R89W	S31	NW¼NE¼
P6774.0P	Thompson J. L.	South #4	160	STK	T34N	R90W	S11	NE¼NW¼
P169586.0W	Burgett Glenn H.	Liam	0	STK	T34N	R90W	S36	NE¼NE¼
P13585.0P	Wyoming State Board of Land Commissioners/ Diamond Ring Ranch	Delfelder #3	200	STK	T35N	R89W	S36	NW¼NW¼
P18295.0W	Miles Nellie K./ Miles James N.	Miles #4	328	DOM_GW; STK	T35N	R89W	S32	NE¼NW¼
P18296.0P	Miles Nellie K./ Miles James N.	Miles #5	368	STK	T35N	R89W	S32	NE¼NW¼
P179706.0W	Hansen William	Bill Hansen #1	40	STK	T40N	R116W	S18	NE¼SW¼
P181273.0W	Anobile John R. and Melissa A.	Anobile #1	320	DOM_GW	T50N	R82W	S06	NE¼NW¼
P180954.0W	J.M. Huber, Corp.	Maniqault Fed 9LW-28 57-75	612	CBM; STK	T57N	R75W	S28	NE¼SE¼

[a] Wells located within the GPHA.

Source: WSEO 2012.

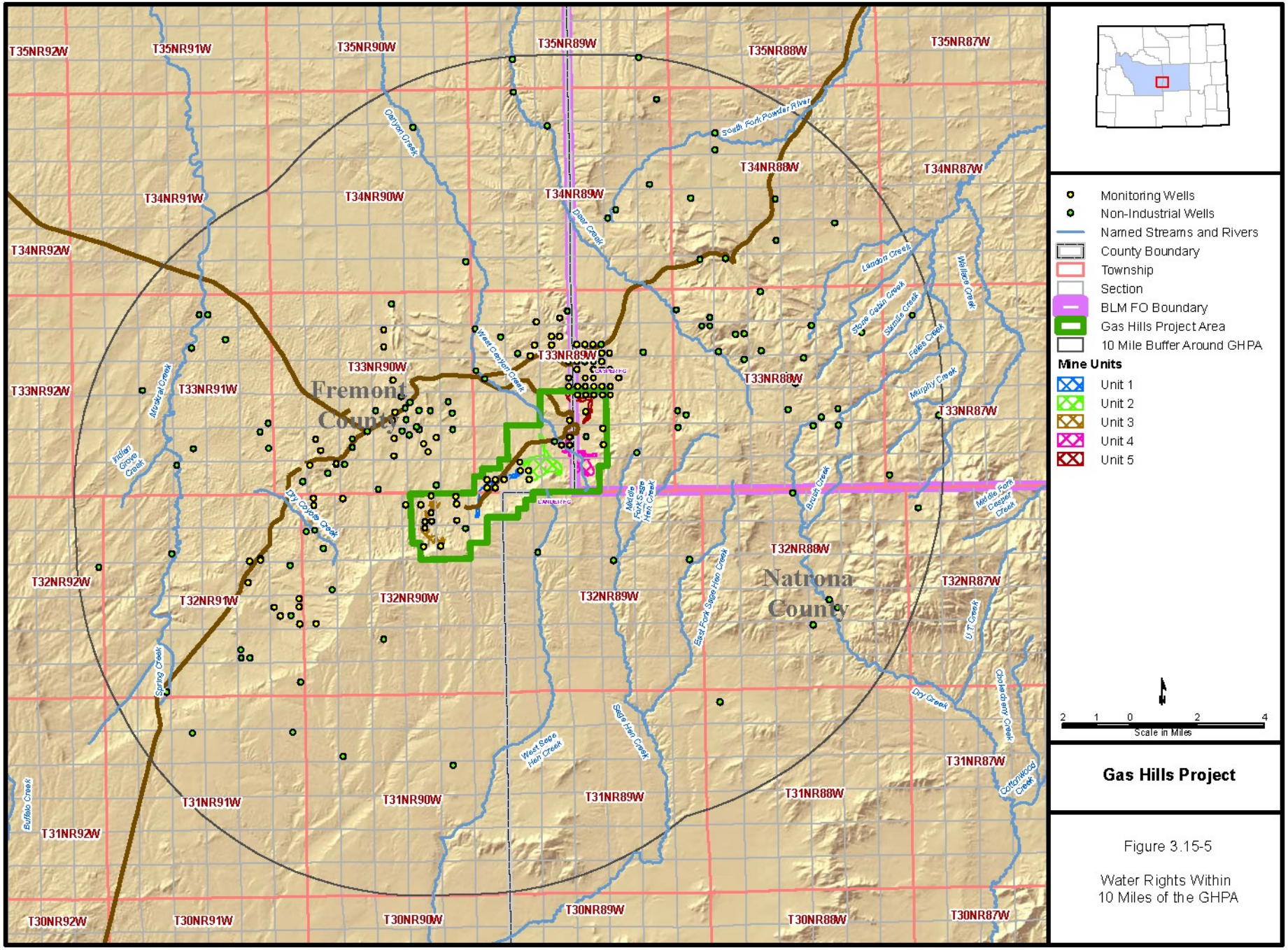


Figure 3.15-5

Water Rights Within 10 Miles of the GHPA

3.16 Wild Horses

Management of wild horses on BLM-administrated lands is regulated under the Wild Free-Roaming Horses and Burros Act of 1971, the multiple use objectives of the FLPMA, and the Wyoming Standards of Healthy Rangelands. Within the state of Wyoming there are currently 16 Herd Management Areas (HMAs) with a target wild horse population of 3,725 (BLM 2009b). Appropriate management levels were established in 1993 and 1994 and acknowledged throughout the state for each HMA through a 2003 Consent Decree between the State of Wyoming and the BLM. The appropriate managed level establishes a herd population range for the HMAs that ensures a healthy balance between all grazing activity (wild horses, livestock, and wildlife) and the vegetation, water, and soil resources that supports them. Vegetative community health within the HMAs is assessed using the Wyoming Standards for Healthy Rangelands. Drought conditions reduce available forage for wild horses, which may increase grazing competition between horses and livestock. Dietary overlap occurs between wild horses and cattle, although there are some differences. Horses tend to be less selective and will graze vegetation closer to the ground, sometimes creating adverse effects (BLM 2007d).

Due to a lack of natural predators, wild horse reproduction and recruitment rates exceed mortality rates. Therefore, herd populations are controlled artificially to maintain the health of horses and rangelands. Population size, drought conditions, and vegetation monitoring typically dictate the timing and frequency of the gathers. Herd populations increase at approximately 15 to 20 percent annually (BLM 2011b, Lander Draft RMP and EIS). Generally, gathers are conducted every 3 to 5 years, at which time the overall health of the population is assessed. To maintain the appropriate management levels, some horses are removed and an anti-fertility vaccine (Porcine Zona Pellocida) is administered to mares.

3.16.1 Muskrat Basin, Conant Creek, Rock Creek, and Dishpan Butte HMAs

Although no wild horse HMAs overlap the GHPA, the Muskrat Basin HMA lies 5 miles to the southwest (**Figure 3.16-1**). This HMA is adjacent to 3 other HMAs; Conant Creek, Rock Creek, and Dishpan Butte. Although these horse herds are managed as individual populations there is no geographical separation between them and gates remain open for most of the year. Due to connectivity these HMAs are frequently referred to as the North Lander Complex of HMAs. The free-roaming nature of wild horses and the openness of these HMAs benefit the genetic viability of the wild horse populations. This North Lander Complex of HMAs consists of approximately 375,300 acres and is located in central Fremont County. The total appropriate management level ranges from 320 to 536 horses with no wild burro populations (see **Table 3.16-1** for individual HMA statistics). Over the last 10 years, 667 horses have been removed from the complex during gathers.

Table 3.16-1 Herd Management Areas and Appropriate Management Levels

HMA	BLM Acres	Other Acres	Appropriate Management Level (number of horses)	Number Removed from 2004 Gather
Conant Creek	49,528	8,190	60-100	95
Dishpan Butte	92,275	7,466	50-100	123
Muskrat Basin	176,340	16,922	160-250	127
Rock Creek	19,100	5,483	50-86	0

Source: Tabular data was obtained from BLM (2009a).

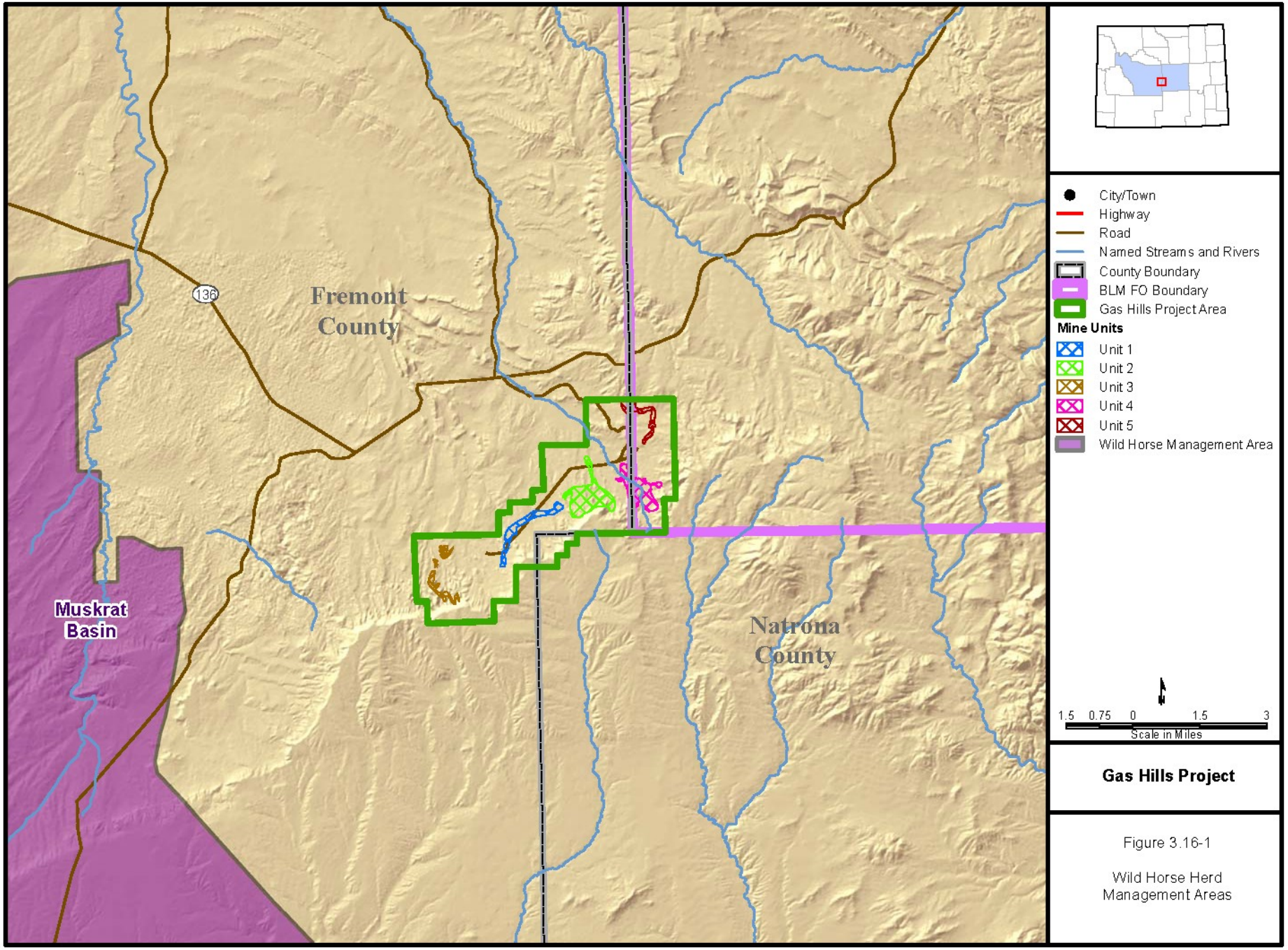


Figure 3.16-1

Wild Horse Herd Management Areas

3.17 Wildlife and Fisheries

The study area for wildlife and fisheries resources is defined as the area encompassed by the GHPA. The study area is characterized by flat to low rolling terrain with intermittent terraces, steep slopes, and rocky ridges. As discussed in Section 3.13, Vegetation, 7 vegetation cover types, and 1 land use cover type is located within the study area. Vegetation cover types include bottomland sagebrush, mixed sagebrush grassland, rough breaks, upland grass, reclaimed areas, reservoirs, and wetlands. The land use cover type is disturbed land. Mixed sagebrush grassland is the most common vegetation community within the study area. A variety of wildlife species are associated with upland communities found within the study area, with greater species diversity occurring in areas exhibiting greater vegetation structure and soil moisture, such as wetlands. Due to a lack of perennial water sources that provide suitable aquatic habitat, no fisheries are known to occur within the study area and therefore not discussed further in this section.

Information regarding wildlife and fisheries resources and their habitat within the study area and CISAs was obtained from a review of existing published sources, BLM, WGFD, and USFWS file information, WYNDD database information, and site-specific surveys conducted by HWA (2010, 2009).

3.17.1 Terrestrial Wildlife

Wildlife species that may occur within the study area are typical of the grassland and sagebrush shrub communities of central Wyoming. Baseline descriptions of both resident and migratory wildlife include species that have either been documented within the study area or those that may occur within the study area based on habitat associations. Species that inhabit wetland/waterbody habitat are limited to the intermittent drainages, ponds, and wetlands that occur within the study area or occur in the immediate vicinity.

Available water for wildlife consumption is limited within the study area. Clean water sources, particularly those that maintain open water and a multi-story canopy, support a greater diversity and population density of wildlife species than any other habitat types occurring in the region.

3.17.1.1 Big Game Species

Big game habitat information (e.g., crucial winter habitat, parturition habitat, migration corridors, etc.) and Geographic Information System (GIS) shapefiles were obtained from the WGFD and reviewed for this Project. This information is updated regularly and presents the most accurate data for the study area. Big game species that may occur within the study area include pronghorn, mule deer, and elk (BLM 2007a; WGFD 2004). The study area does not contain any big game crucial winter habitat or parturition habitat identified by the WGFD. Recent surveys in 2010 and 2011 have documented pronghorn, mule deer, and elk within the study area (HWA 2011a,b).

Pronghorn are most prominent in portions of the study area with adequate forage and surface water (BLM 2007a; WGFD 2004). Pronghorn inhabit grasslands and sagebrush shrublands in flat to rolling topography and browse on shrubby plants, especially sagebrush, throughout the year. During the winter, pronghorn generally utilize areas of relatively high sagebrush densities and overall low snow accumulations, on south- and east-facing slopes. The WGFD has classified the study area into 2 categories for pronghorn: spring/summer/fall and yearlong range. The study area is located within WGFD's Pronghorn Herd Unit 632 (Beaver Rim). In 2009, WGFD trend data indicated a total of 24,938 animals in this herd unit (WGFD 2009a). This is an overall increase in the number of animals in the herd unit since 2000 (average of 23,654 animals from 2000 to 2009). Over the past 5 years, annual harvest estimates indicate 1,253 animals per year have been harvested in Pronghorn Herd Unit 632. Overall, populations of pronghorn within the Project region have increased since the early 2000s.

Mule deer may occur throughout the study area. Mule deer feed on a wide variety of plants including forbs, grasses, sedges, shrubs, and trees. Like pronghorn, winter habitat for mule deer occurs in areas of

relatively high sagebrush densities and overall low snow accumulation, on south- and east-facing slopes. The WGFD has classified the study area into 2 categories for mule deer; yearlong and winter/yearlong range. The study area is located within WGFD's Mule Deer Herd Units 646 (Sweetwater) and 648 (Beaver Rim). In 2009, the WGFD estimated a total population of approximately 6,198 animals in Mule Deer Herd Unit 646 and 1,266 animals in Mule Deer Herd Unit 648 (WGFD 2009a). This is an overall increase in the number of animals since 2000 (average of 4,933 animals in Mule Deer Herd Unit 646 and 949 animals in Mule Deer Herd Unit 648 from 2000 to 2009). Over the past 10 years, annual harvest estimates indicate approximately 51 and 427 animals per year harvested in Mule Deer Herd Units 646 and 648, respectively (WGFD 2009b). Similar to pronghorn populations, mule deer populations within the Project region have increased since the early 2000s. However, despite the higher availability of pronghorn antelope in the GHPA, mule deer are hunted at a higher rate.

Elk also occur infrequently within the study area, particularly in the fall and winter months. In the open sagebrush shrublands of Wyoming, elk typically roam over vast expanses away from human development. The WGFD has classified the majority of the study area as not containing elk habitat; however, a small portion in the southeastern corner of the study area is classified as yearlong range. The study area is located within WGFD's Elk Herd Unit 638 (Green Mountain). In 2009, the population of elk in Herd Unit 638 was unknown, although the herd is managed with a population goal of 500 animals. Over the past 5 years, annual harvest estimates indicate approximately 258 animals per year have been harvested in Elk Herd Unit 638 (WGFD 2009b). Similar to pronghorn and mule deer, populations of elk within the Project region have increased since the early 2000s.

Black bears and mountain lions also are classified as big game species in Wyoming (WGFD 2009a). Both species are fairly common in Wyoming, especially in high elevation forests and riparian areas. Both species occur at very low densities in habitats found within the study area (e.g., mixed sagebrush grassland, rough breaks, etc.); therefore, their potential for occurrence is extremely low.

3.17.1.2 Small Game Species

Small game species that occur within the study area include upland game birds, small mammals, furbearers, and waterfowl. Upland game birds that occur within the study area include greater sage-grouse and mourning dove. The greater sage-grouse is a federal ESA candidate, BLM-sensitive species and is discussed further in Section 3.17.2, Special Status Wildlife Species. Mourning dove occur in habitats ranging from deciduous forests to shrubland and grassland communities, often nesting in trees or shrubs near riparian areas or water sources. Small game mammals likely to occur within the study area include desert cottontail and red fox. Furbearers likely to occur within the study area include badgers and bobcats (BLM 2007a; WGFD 2004). These species have a wide distribution in Wyoming and are found within a variety of habitat types including bottomland sagebrush, mixed sagebrush grassland, rough breaks, upland grass, reclaimed areas, and wetlands.

The study area is located within the Central Flyway, which is 1 of the 4 USFWS designated migratory bird flyways in North America. Common waterfowl species that may occur within the study area year-round depending on the availability of open water include Canada goose, mallard, green winged teal, northern pintail, gadwall, and American widgeon. Other common summer residents include blue-winged teal, cinnamon teal, northern shoveler, redhead, and ring-necked duck (BLM 2007a; HWA 2011a; Stokes and Stokes 1996; WGFD 2004). These species distributions are limited to the ponds and wetland/riparian habitats found within the study area.

3.17.1.3 Nongame Species

A diversity of nongame species (e.g., small mammals, raptors, passerines, amphibians, and reptiles) occupies a variety of trophic levels and habitat types within the study area. Common nongame wildlife species include small mammals such as bats, voles, squirrels, gophers, prairie dogs, woodrats, and mice. These small mammals provide a substantial prey base for predators in the Project region including larger mammals (long-tailed weasel, short-tailed weasel, raptors (eagles, buteos, accipiters, owls), and

reptiles (snakes). The white-tailed prairie dog is a BLM sensitive species and is discussed further in Section 3.17.2, Special Status Wildlife Species. A number of bat species also occur within the study area, including little brown myotis, big brown bat, and western small footed myotis (WGFD 2010a, 2004). BLM sensitive bat species are discussed further in Section 3.17.2, Special Status Wildlife Species.

Raptors and Other Migratory Birds

Nongame birds encompass a variety of passerine and raptor species including migratory bird species that are protected under the MBTA (16 USC 703-711) and EO 13186 (66 Federal Register 3853). Pursuant to EO 13186, a MOU between the BLM and USFWS outlines a collaborative approach to promote the conservation of migratory bird populations. The purpose of the MOU is to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds in coordination with state, tribal, and local governments. This MOU identifies specific activities where cooperation between the BLM and USFWS would contribute to the conservation of migratory birds and their habitat.

Raptor species that could potentially occur as residents or migrants within the study area include eagles (bald and golden eagles), buteos (e.g., red-tailed hawk, Swainson's hawk, ferruginous hawk), falcons (e.g., prairie falcon, American kestrel), accipiters (e.g., Cooper's hawk, sharp-shinned hawk), owls (e.g., great horned owl, burrowing owl, long-eared owl, short-eared owl), northern harrier, and turkey vulture (BLM 2007a; HWA 2011a,b; Stokes and Stokes 1996; WGFD 2004). Breeding raptor surveys were conducted within the study area in 2009, 2010, and 2011 using both aerial and ground inventory procedures (HWA 2011a,b). The raptor surveys were conducted during May, June, and July to identify occupied territories or active nest sites located within 1 mile from the outside edge of the study area. Aerial surveys focused on cliff nesters (e.g., golden eagle, prairie falcon) and species that commonly build nests in deciduous trees or on promontory points (e.g., red-tailed hawk, Swainson's hawk, ferruginous hawk, great-horned owl). The aerial surveys did not concentrate on cavity nesters (e.g., American kestrel), ground nesters (e.g., northern harrier), subterranean nesters (e.g., burrowing owl), or most conifer nesters (e.g., accipiters), based on visibility limitations from the airplane. These species were surveyed for with subsequent ground surveys conducted in June and July within 1 mile of the study area.

Based on the results of the 2011 ground raptor nest surveys, 40 nest sites (3 new and 37 historic) were identified within 1 mile of the study area. Of these 40 nest sites, 1 was active, 31 were inactive, and 8 were determined to be deteriorated beyond use (HWA 2011b). The 1 active nest site was occupied by ferruginous hawks.

A variety of passerines occur within the study area throughout the year; however, they are most abundant during the spring/fall migration as well as during the breeding season (May 15 to June 30 [Nicholoff 2003]). Representative bird species that occur in the study area include Say's phoebe, horned lark, barn swallow, black-billed magpie, American raven, western meadowlark, green-tailed towhee, lark bunting, and lark sparrow (BLM 2007a; Stokes and Stokes 1996; WGFD 2004). BLM sensitive migratory bird species are discussed further in Section 3.17.2, Special Status Wildlife Species.

Birds of Conservation Concern and Wyoming Partners in Flight Priority Bird Species

A list of Birds of Conservation Concern was developed as a result of a 1988 amendment to the Fish and Wildlife Conservation Act. This Act mandated that the USFWS "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973." The goal of the Birds of Conservation Concern list is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions, and that these species would be consulted on in accordance with EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (USFWS 2008). Important bird species that potentially could occur within the study area and their associated habitat types are presented in **Appendix D**. The study area is located within Bird Conservation Region 10, Northern Rockies. This BCR

contains large tracts of high elevation forests and sagebrush shrublands in Montana, Idaho, and Wyoming and is a major migration corridor for bird species migrating to and from western Canada through the U.S.

Partners in Flight (PIF) is a multi-faceted organization with the goal of documenting and reversing population declines of neotropical migratory birds and their habitats (Nicholoff 2003). PIF Priority Bird Species that potentially could occur within the study area and their associated habitat types are presented in **Appendix D**.

Reptiles and Amphibians

Reptiles and amphibians occupying the study area are typically limited by their specific habitat requirements. Potential habitat for amphibians within the study area includes intermittent stream reaches, wetlands, springs, reservoirs, and ephemeral ponds. Species that could potentially occur within the study area include the eastern short-horned lizard, northern sagebrush lizard, prairie rattlesnake, northern leopard frog, chorus frog, and Great Basin spadefoot toad (Baxter and Stone 1980; BLM 2007a; WGFD 2010a, 2004). Surveys conducted in 2010 and 2011 documented boreal chorus frogs and tiger salamanders within the study area (HWA 2011b). BLM sensitive reptile and amphibian species are discussed further in Section 3.17.2, Special Status Wildlife Species.

3.17.2 Special Status Wildlife Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Twenty-seven special status wildlife species including federally listed, federally proposed, federal candidate, and BLM sensitive species were identified as potentially occurring within the study area (BLM 2010b, 2007a; USFWS 2010a,b; WGFD 2010a,b) (**Appendix C**). The potential occurrence of special status species within the study area was based on range, known distribution, and the presence of potentially suitable habitat within the study area. A total of 13 wildlife species were eliminated from detailed analysis (black-footed ferret, swift fox, long-eared myotis, bald eagle, northern goshawk, peregrine falcon, long-billed curlew, white-faced ibis, yellow-billed cuckoo, trumpeter swan, boreal toad, Columbia spotted frog, and Yellowstone cutthroat trout) based on rationale presented in **Appendix C**. The remaining 14 wildlife species that have the potential to occur within the study area are discussed below.

3.17.2.1 Mammals

White-tailed Prairie Dog

The white-tailed prairie dog (*Cynomys leucurus*) is classified as a BLM sensitive species. White-tailed prairie dogs inhabit xeric sites with mixed shrubs and grasses. This species is often associated with sagebrush and saltbrush and tends to occupy higher elevations (greater than 5,500 feet amsl) than the black-tailed prairie dog (WGFD 2010a). In Wyoming, the white-tailed prairie dog is found in the western 2/3 of the state, excluding the areas near Yellowstone and Grand Teton National parks (WGFD 2010a).

White-tailed prairie dog surveys were conducted during the summer months in 2009, 2010, and 2011 to determine location, size, and density of active colonies. Nine white-tailed prairie dog colonies (4 active and 5 inactive), encompassing 18.7 acres, were located within the study area (**Figure 3.17-1**) (HWA 2011a,b). Based on the results of these surveys, the potential for this species to occur within the study area is considered high.

Pygmy Rabbit

The pygmy rabbit (*Brachylagus idahoensis*) is classified as a BLM sensitive species. Pygmy rabbits inhabit sagebrush shrublands and require dense sagebrush canopies with deep soils with high clay content for burrowing. This species is often found in drainages with tall sagebrush present (BLM 2004; WGFD 2010a). Surveys in 2009 documented marginal habitat within the GHPA (HWA 2009). Pygmy

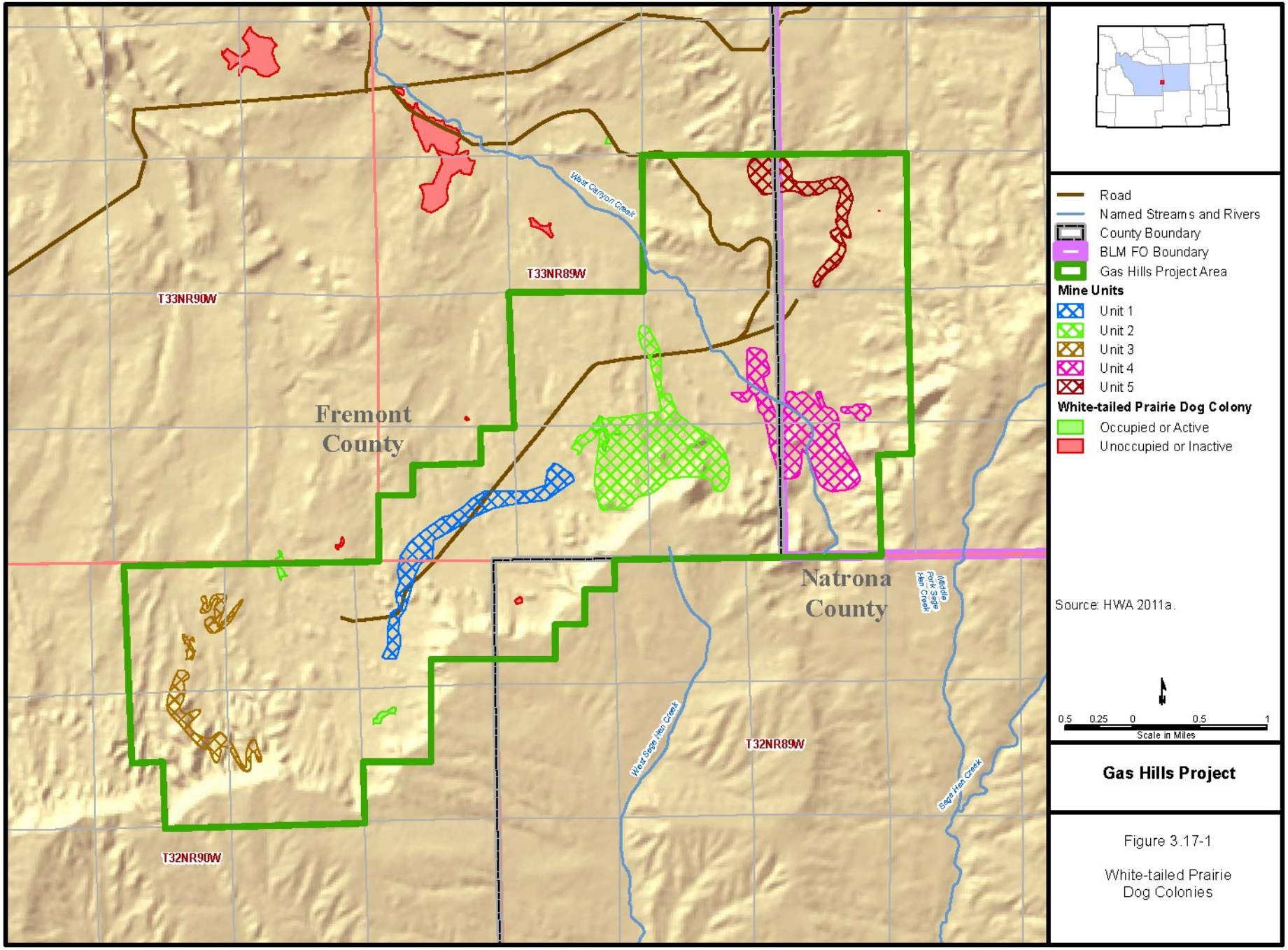


Figure 3.17-1

White-tailed Prairie Dog Colonies

rabbit occurrence surveys were conducted in June 2009 and December 2009 in order to search for pygmy rabbit sign (e.g., tracks, droppings). These 2 survey efforts found no sign of pygmy rabbits (HWA 2011a) and at this time it is assumed that pygmy rabbits do not occupy the GHPA. Based on marginal habitat and no known occurrence of this species within the GHPA, the potential for this species to occur within the GHPA is low.

Sensitive Bat Species

The Townsend's big-eared bat (*Corynorhinus townsendii*) and spotted bat (*Euderma maculatum*) are classified as BLM sensitive species. These species occur in a wide variety of habitats including semi-desert scrub, sagebrush shrubland, grassland, coniferous forest, and riparian areas. Roost sites consist of buildings, caves, mines, rock crevices, trees, and cliffs (Fitzgerald et al. 1994; WGFD 2010a). Based on the presence of suitable foraging habitats (and roosting habitat for the Townsend's big-eared bat), the potential for these species to occur within the study area is considered high.

3.17.2.2 Birds

Ferruginous Hawk

The ferruginous hawk (*Buteo regalis*) is classified as a BLM sensitive species. The ferruginous hawk breeds from the Canadian Prairie Provinces south to Oregon, Nevada, Arizona, and Oklahoma. It winters from the central and southern portions of its breeding range south into Baja, California and central Mexico. This species inhabits semiarid open country, primarily grasslands, basin-prairie shrublands, and badlands. It requires large tracts of relatively undisturbed rangeland and nests on rock outcrops, the ground, knolls, cliff ledges, or trees (Johnsgard 1990; WGFD 2010a). This species is found throughout Wyoming, although it is most common in the south-central portion of the state (WGFD 2010a). One active ferruginous hawk nest was found during the 2010 raptor nest surveys. However, this nest is greater than 1 mile northwest of the study area (HWA 2011a,b). Based on the results of the raptor nest survey and suitable nesting and foraging habitat, the potential for this species to occur within the study area is considered high.

Burrowing Owl

The burrowing owl (*Athene cunicularia*) is classified as a BLM sensitive species. This species breeds from south-central British Columbia, south through most of the western U.S., and Mexico (WGFD 2010a). This species typically inhabits level, open areas in heavily grazed or low-stature desert vegetation, with available burrows for nesting and cover (Johnsgard 1988; WGFD 2010a). Nesting habitat consists of abandoned mammal burrows on flat, dry, and relatively open terrain (Johnsgard 1988). While suitable habitat (e.g., white-tailed prairie dog colonies) occurs within the study area, no burrowing owls have been observed in recent years within the study area (HWA 2011a,b). Due to the presence of active white-tailed prairie dog colonies and mixed sagebrush grassland habitat, the potential for this species to occur within the study area is considered high.

Greater Sage-grouse

The greater sage-grouse (*Centrocercus urophasianus*) is classified as a federal candidate species as well as a BLM sensitive species. On March 5, 2010, the USFWS determined that the greater sage-grouse warrants protection under the ESA; however, the USFWS concluded that proposing the species for protection is precluded by the need to take action on other species facing more immediate and severe extinction threats. Therefore, greater sage-grouse in Wyoming continue to be managed by the WGFD. Conservation efforts for this species in Wyoming are currently coordinated by the WGFD in cooperation with the USFWS, BLM, and regional greater sage-grouse working groups in an attempt to increase population levels and avoid federal listing under the ESA. In an effort to prevent federal listing of greater sage-grouse, the Wyoming Greater Sage-grouse Implementation Team and local greater sage-grouse working groups have recently completed a revised map (version 3) of greater sage-grouse core population areas in Wyoming. Greater sage-grouse core population areas include areas with the highest densities of breeding greater sage-grouse in the state, as well as areas important for connectivity between populations. The core population areas include roughly 25 percent of the state but contain

83.1 percent of the greater sage-grouse population in the state. The GHPA contains 12 acres of core population area (Greater South Pass) (**Figure 3.17-2**).

Lekking/Nesting Habitat

The center of breeding activity for greater sage-grouse is referred to as strutting ground or a lek. Leks typically are characterized as flat, sparsely vegetated areas within large tracts of sagebrush (Connelly et al. 2004). Males begin to appear on leks in March with peak attendance of Wyoming leks occurring in April (WGFD 2010b). Greater sage-grouse nesting habitat typically is centered on active leks and consists of medium to tall sagebrush with a perennial grass understory (Connelly et al. 2000). Studies have shown that taller sagebrush with larger canopies and more residual understory cover usually lead to higher nesting success (Connelly et al. 2004, 2000). A total of 20 lek sites have been identified within 11 miles of the study area and 2 leks have been identified within 4 miles of the study area. All of these leks are classified as "occupied" by the WGFD. The closest leks are 0.78 mile (West Canyon Creek lek) and 1.85 miles (Puddle Springs lek) north and west of the of the study area. Both of these leks were determined to be active in 2009 and 2010 as males were observed on the leks during the breeding season (**Table 3.17-1**).

Table 3.17-1 Activity Status of Greater Sage-grouse Leks Located within 2 Miles of the GHPA[a]

Name of Lek	Year	Active (Yes/No/Unknown)	Maximum Number of Males Observed	Date of Maximum Count
Puddle Springs	2008	Yes (1st year discovered)	10	April 17
	2009	Yes	1	May 12
	2010	Yes	12	April 26
	2011	Yes	9	April 5
West Canyon Creek	2001	Unknown	-	Not checked.
	2002	Unknown	-	Not checked.
	2003	Yes	2	April 3
	2004	Unknown	0	April 3
	2005	Unknown	-	Not checked.
	2006	Unknown	0	April 13
	2007	Unknown	-	Not checked.
	2008	Yes	40	April 14
	2009	Yes	30	May 12
	2010	Yes	17	April 17[b] April 26[b]
	2011	Yes	9	April 5

[a] Wyoming EO 2011-5 states that a 2 mile buffer of occupied leks is required for leks outside core areas.

[b] A maximum of 17 males was counted during both the April 17th and the April 26th survey.

Source: HWA 2011a,b, 2010; WGFD 2010b.

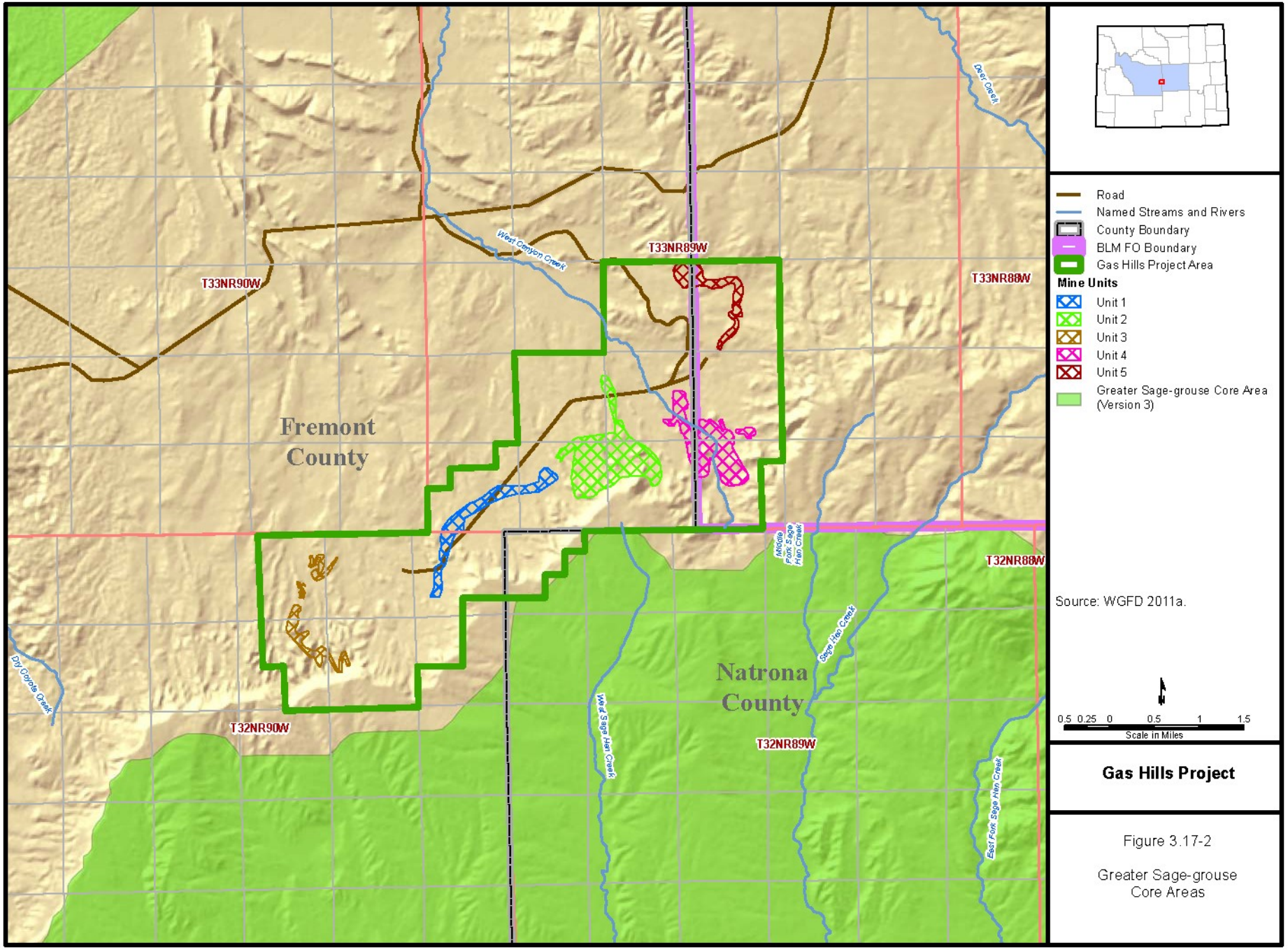


Figure 3.17-2

Greater Sage-grouse Core Areas

Brooding Habitat

During the late spring and summer, hens and broods typically are found in more lush habitats consisting of a high diversity of grasses and forbs that attract insects while providing cover from predators. These habitats include wet meadows, riparian areas, and irrigated farmland within or near sagebrush. Hens with broods utilize these habitats until forbs desiccate and insect abundance decreases. Unsuccessful hens and cocks also utilize these same habitats; however, due to their nutritional flexibility, they are able to occupy a wider variety of habitats during the spring and summer months (Connelly et al. 2004). In many greater sage-grouse populations, high quality brooding habitat is often the limiting factor due to drought, invasive weeds, and overgrazing associated with improper range management. The GHPA contains suitable brooding habitat and surveys in 2010 documented several hens with broods in sagebrush habitat near a reservoir in the western portion of the study area (HWA 2011a).

Wintering Habitat

Depending on the severity of the winter, greater sage-grouse move to south- and east-facing slopes that maintain exposed sagebrush. Studies have shown that south-facing slopes with sagebrush at least 10 to 12 inches above the snow level are required for both food and cover. Windswept ridges, draws, and swales also may be used, especially if these areas are in close proximity to exposed sagebrush (Connelly et al. 2004). In years with severe winter conditions (i.e., deep snow), greater sage-grouse would often gather in large flocks in areas with the highest quality winter habitat. It is suggested that high quality winter habitat is limited in portions of the greater sage-grouse's range (Connelly et al. 2000). While no winter concentration areas have been mapped within the GHPA, suitable sagebrush habitat is present within the GHPA that may provide habitat for winter greater sage-grouse.

Based on the presence of active leks near the study area and suitable nesting, brooding, and wintering habitat, the potential for this species to occur within the study area is considered high.

<u>Brewer's Sparrow, Loggerhead Shrike, Sage Sparrow, Sage Thrasher</u>

The Brewer's sparrow (*Spizella breweri*), loggerhead shrike (*Lanius ludovicianus*), sage sparrow (*Amphispiza belli*), and sage thrasher (*Oreoscoptes montanus*) are classified as BLM sensitive species. These species typically are found in open habitats, including grassland, sagebrush shrubland, semi-desert scrub, and agricultural areas (BLM 2007a; WGFD 2010a). Surveys in 2010 documented Brewer's sparrows and loggerhead shrikes in suitable habitats but sage sparrows and sage thrashers were not documented within the study area (HWA 2011a; WGFD 2010a). However, based on the presence of suitable habitat, the potential for these species to occur within the study area is considered high.

<u>Mountain Plover</u>

The mountain plover (*Charadrius montanus*) is classified as a BLM sensitive species. The historic breeding range of the mountain plover included short-grass prairies from extreme southern Canada, south through the Great Plains of the U.S. (WGFD 2010a). Currently, mountain plovers only nest in isolated areas throughout their range. In Wyoming, the breeding range of this species is widespread and relatively common in favored habitat; however, population levels and trends are not known (WGFD 2010a). Breeding habitat for this species appears to vary geographically. However, throughout its range, suitable breeding habitat is characterized primarily by shortgrass prairie grassland where grazing is intensive, or in areas of fallow fields or active prairie dog towns (WGFD 2010a). Ground surveys were conducted in 2009, 2010, and 2011, to determine location, size, and species composition of suitable habitat. A total of 141 acres of potentially suitable habitat was mapped within 0.25 mile of the study area (**Figure 3.17-3**) (HWA 2011a,b). Based on the known distribution of the mountain plover in Wyoming, and documented observations within the study area in 2009 and 2010 (HWA 2011a,b), the potential for this species to occur within the study area is considered high.

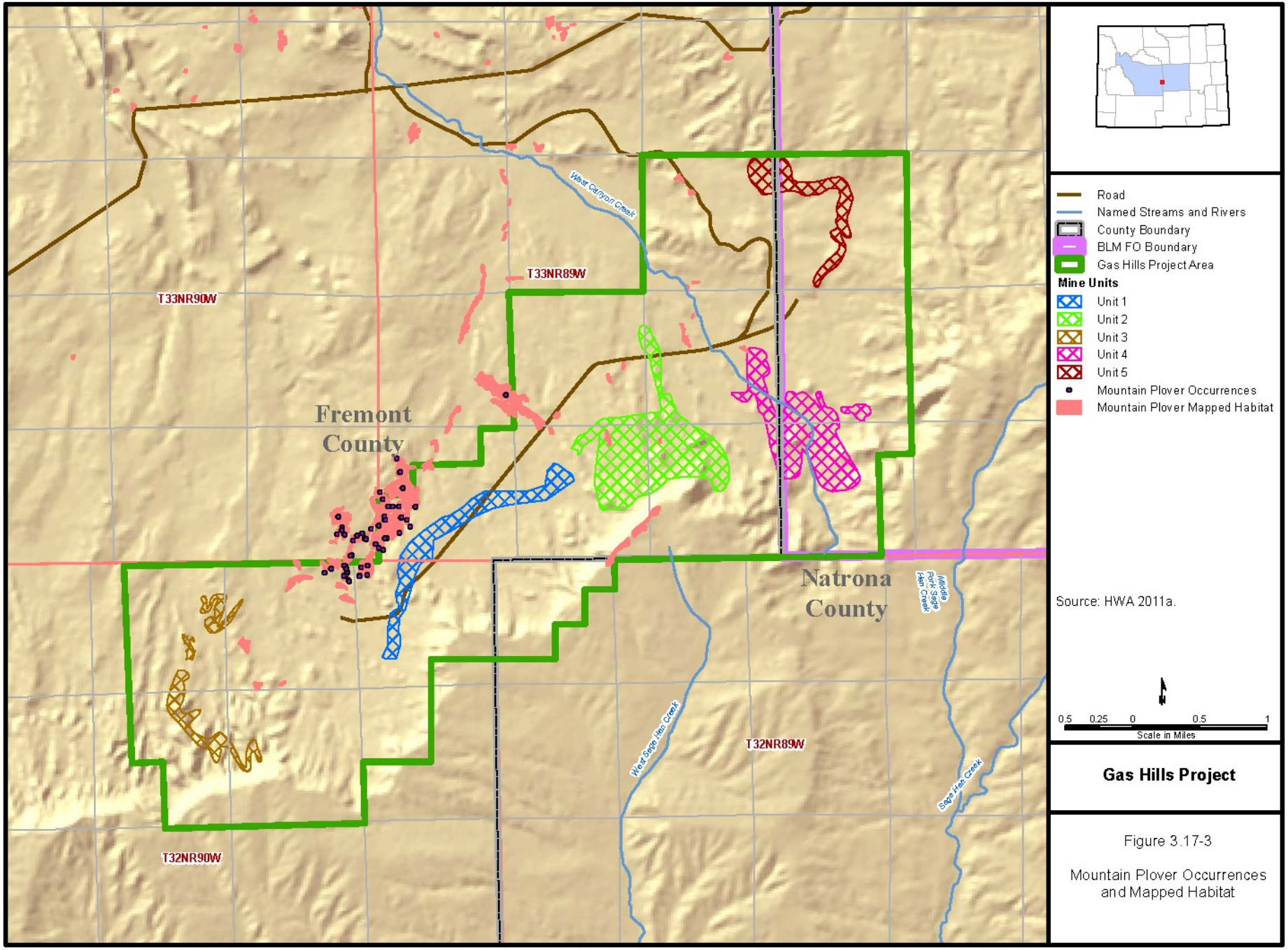


Figure 3.17-3

Mountain Plover Occurrences and Mapped Habitat

3.17.2.3 Reptiles and Amphibians

Northern Leopard Frog

The northern leopard frog (*Rana pipiens*) is classified as a BLM sensitive species. It is one of the most common and widespread amphibians in the U.S.; however, populations are known to be declining throughout its range. This species is found in or near permanent water in the plains, foothills, and montane zones. Northern leopard frogs have been documented up to 11,000 feet amsl in mountainous portions of their range. Preferred habitats are swampy cattail marshes on the plains and beaver ponds in the foothills and montane zones. This species is common throughout Wyoming except in Teton County, Park County, and Yellowstone National Park (WGFD 2010a). While surveys in 2010 did not document northern leopard frogs within the study area (HWA 2011a), the potential for this species to occur within the study area is considered high due to the presence of suitable habitat.

Great Basin Spadefoot

The great basin spadefoot (*Spea intermontana*) is classified as a BLM sensitive species. This species ranges from southern British Columbia south through the Great Basin to northern Arizona and New Mexico. The Great Basin spadefoot prefers sagebrush communities below 6,000 feet amsl, although they have been found at elevations of 9,200 feet amsl. This species requires loose soil for burrowing. In Wyoming, this species is most abundant west of the Continental Divide in the Wyoming Basin and the Green River Valley, but in the center of the state, it crosses the Divide into Fremont and Natrona counties (WGFD 2010a). While surveys in 2010 did not document Great Basin spadefoots within the study area (HWA 2011a), the potential for this species to occur within the study area is considered high due to the presence of suitable habitat.

4.0 Environmental Consequences

This chapter describes the environmental consequences, also referred to as “impacts” or “effects,” associated with the Project and alternatives described in Chapter 2.0. Impacts are analyzed based on application of applicant-committed measures described in Section 2.3.9, Applicant-committed Environmental Protection Measures. The analysis considers the existing conditions within the affected environment presented in Chapter 3.0, identifies the types of impacts from the Project and alternatives, and quantifies the impacts to the extent practicable for disclosure in this EIS. The types of impacts disclosed include the following:

- **Direct Impacts** – The effects that are caused by the action and occur at the same time and place. Examples include the elimination of original land use due to the erection of a structure.
- **Indirect Impacts** – The effects that are indirectly caused by the action. They occur later or are farther removed in distance, but are still reasonably foreseeable and related to the action by a chain of cause and effect. Indirect impacts may reach beyond the natural and physical environment (e.g., environmental impact) to include growth-inducing effects and other effects related to induced changes to resource users (e.g., non-environmental impact).

Final location of wells and infrastructure within each mine unit would be determined in detail based on the results of hydrologic testing performed prior to mine unit development, as described in Section 2.3.2, Mine Unit Construction. While precise location has not been determined for Project components within individual mine units, disturbance and impacts associated with them are sufficiently captured for analysis through assumptions for each alternative presented in Chapter 2.0, Proposed Action and Alternatives.

The impact analysis is designed to show relative differences in alternatives as they pertain to specific resources, resource uses, or social and economic features. It is not intended to predict the exact amount, timing, or location of effects that could occur should the alternative be selected for implementation. The numbers generated in this analysis are approximations, and are intended for comparison of impacts only.

Each resource section includes a discussion of the resource-specific analysis area and assumptions used in the analysis, followed by the direct and indirect impacts of each alternative. As part of the impact analysis for each resource, discussions on the following are included:

- **Mitigation and Mitigation Effectiveness** – BLM-imposed mitigation measures designed to reduce, minimize, or mitigate environmental effects that could occur as a result of the Project, as well as anticipated benefits from implementation of those measures.
- **Residual Impacts** – Impacts anticipated to remain after mitigation measures have been applied.
- **Irreversible and Irretrievable Impacts** – Permanent loss of future use of a resource (irreversible), and temporary loss of a renewable resource (irretrievable impacts) that would occur as a result of the Project.
- **Relationship between Local Short-term Uses and Long-term Productivity** – Both adverse and beneficial short-term uses of the human environment, and any detrimental impacts on the achievement or maximization of long-term productivity anticipated due to the Project

The cumulative impacts of each alternative, when added to past, present, and reasonably foreseeable future activities, are discussed in Chapter 5.0.

4.1 Air Quality

The analysis of air quality impacts involves estimating emissions from Project activities and air pollutant concentrations at receptors at and beyond the boundaries of the GHPA. The analysis area for air quality impacts includes the areas at the boundary of GHPA and a 5-km buffer.

Air quality issues associated with construction and operation of the Project were identified by BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process. Issues identified included fuel combustion and fugitive dust emissions from the following:

- Construction equipment and vehicles for site preparation, reclamation, and decommissioning of surface facilities;
- Well-drilling equipment and vehicles for drilling production and monitor wells;
- Natural gas- or propane-fired heating units for the satellite facility;
- Trucks for transporting construction materials as well as the product of the Gas Hills Project (uranium-laden ion-exchange resin); and
- Light-duty vehicles for commuting by construction crew and employees.

Direct and indirect impacts were analyzed primarily on the basis of anticipated emissions of criteria pollutants within the analysis area, determined by analyzing the capacity and number of equipment and machines and frequency and duration of operation for each of these emission sources. Methods used for determining impacts are summarized in this section and a detailed description of the methods is included in **Appendix E**.

The following assumptions were used for analysis of impacts to air resources:

- Light vehicles such as pickup trucks weigh 2 tons;
- Heavy trucks weigh 10 tons unloaded and 38 tons loaded;
- Speeds on roads within the GHPA would be limited to 10 mph on 2-track roads, 30 mph on secondary roads, and 40 mph on primary roads (Sections 2.3.2.4, Access Roads, Header Houses, and Underground Utilities and Section 2.3.1.3, Access Roads);
- Air impacts primarily would be generated from within the GHPA and along project transportation routes; and
- Drill rig engines are conservatively assumed to have the same horsepower rating as heavy truck engines.

4.1.1 No Action Alternative

Under the No Action Alternative, in-situ uranium extraction would not take place within the GHPA. The Carol Shop facility, 1 road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres. Exploratory drilling would continue at the rate of approximately 5 acres of disturbance per year.

4.1.1.1 Pollutant Emissions

Under the No Action Alternative, no additional air impacts would be generated within the GHPA by the Project. Air quality in the analysis area would continue to have short-term emissions from exploratory well drilling. Reclamation activities would contribute surface disturbance of 40 acres during reclamation of the Carol Shop facility, road, and topsoil piles, and about 5 acres each year from continued exploratory drilling. These activities would result in the potential to release about 122 tons of PM_{10} and

12 tons of $PM_{2.5}$ during the first year, and about 70 tpy annually thereafter. Mobile combustion sources also would continue to release negligible amounts of other criteria pollutants and HAPs.

4.1.1.2 Greenhouse Gases

Regulated GHGs are comprised of various gases that are known as CO_2 equivalents (CO_2e), which include CO_2, methane, and N_2O. Under the No Action Alternative, emission of GHGs would continue from exploration drilling of a conservatively estimated 40 wells per year, but no Project-related construction would occur. Reclamation also would produce diesel-related GHG emissions at an estimated annual rate of 10 percent of that required if the Project is constructed. Estimated production of GHGs under the No Action Alternative is summarized in **Table 4.1-1**.

Table 4.1-1 Yearly Greenhouse Gas Production under the No Action Alternative

Case	Diesel Consumption (gallons) [a]	Power Consumption (megawatt-hours/year)	Diesel-related GHG (tpy)	Indirect Power-related GHG (tpy)	Total GHG (tpy)
			CO_2e	CO_2e	CO_2e
No Action (stationary sources)	0	0	0	0	0
No Action (mobile sources)	2,198,694	0	24,405	0	24,405
Total No Action	**2,198,694**	**0**	**24,405**	**0**	**24,405**

[a] Assumes drill rigs operate 2,800 hours per year, 1 pickup truck commuting to Riverton 50 weeks per year, and reclamation activities would occur at a rate equal to 10 percent of that required for the Proposed Action.

4.1.2 Proposed Action Alternative

Sources of impacts to air quality associated with the Proposed Action Alternative would include: emissions of fugitive dust from construction disturbances, from wind erosion of unreclaimed areas, and from travel on unpaved roads; emissions of priority pollutants from combustion engines; and emissions of GHGs from combustion engines. The potential for emissions is dependent on the type and amount of activity occurring within a localized area at any point in time. The following analysis was designed to estimate the maximum potential impact of the Project to air quality by looking at Project activities that would contribute the most to air quality impacts, assuming activities would occur in a very small area and at the same point in time, and by assuming weather conditions that would cause the least dispersion of any air pollutants. Screening level modeling was used to perform the impacts analyses.

Project activities during construction, operation, and reclamation would vary as described in Section 2.3, Proposed Action, of this document. **Table 4.1-2** includes a summary of the estimated types of equipment used as well as frequency and duration of operation during each project activity. These estimates were used to calculate the impacts discussed in this section. Additional discussion of methods used to calculate impacts to air quality are included in **Appendix E**.

In general the greatest impact to air quality would occur during construction of mine units, when the operation of drill rigs, as well as the largest amount of surface disturbance, would occur. Total disturbance and the potential for production of fugitive dust from general construction activities would be similar during reclamation. Emissions of dust from truck traffic on roads would be less since there would be fewer trucks (i.e., no drill rigs) during the reclamation phase of the Project. Emissions from engines also would be less during reclamation than emissions during construction as drill rigs would not be operating.

4.1.2.1 Pollutant Emissions

Project activities would generate fugitive dust emissions from surface area disturbance during construction and reclamation activities, as well as from wind erosion of disturbed areas and topsoil stockpiles. Other criteria pollutant emissions would occur from fuel combustion during construction and drilling activities. The primary pollutants emitted would be PM_{10}, $PM_{2.5}$, oxides of nitrogen (NO_X), CO, and SO_2. These emissions potentially would impact air quality in the GHPA.

Emissions of PM_{10} and $PM_{2.5}$ would occur from travel on access roads (unpaved roads), wind erosion at disturbed areas, and from drilling activities. Emissions of NO_X, volatile organic compounds (VOC), CO, and SO_2 would be associated with the construction, operation, reclamation, and decommissioning activities for the Project. Total emissions would include emissions from fuel combustion and fugitive dust emissions arising from the following sources:

- Construction equipment and vehicles used for site preparation, reclamation, and decommissioning of surface facilities;
- Well-drilling equipment and vehicles used for drilling production, injection, and monitor wells;
- Natural gas- or propane-fired heating units used at the Carol Shop facility and proposed satellite facility;
- Trucks for transporting construction materials as well as the uranium-laden ion-exchange resin; and
- Light-duty vehicles for commuting by construction crew and employees.

Air pollutant emissions due to Project operation would occur from hauling product, commuter traffic, and maintenance traffic activities along roads over the lifetime of the Project. Emissions would include exhaust from heavy duty trucks used for transportation, maintenance vehicles, and equipment, as well as fugitive dust from maintenance activities, wind erosion, and other vehicular traffic.

Activities for reclamation that could produce air pollutant emissions include: exhaust from heavy duty trucks used for transportation materials for disposal; construction equipment and exhaust and fugitive dust from vehicles and activities associated with removal of surface structures, buried utilities, evaporation ponds, and roads.

The estimated capacity and number of equipment and machines, and frequency and duration of operation for each of these emission sources is provided in **Table 4.1-2** (U.S. NRC 2004). The hourly emission rates in pounds per hour for the stationary sources (satellite facility heaters) and off-road construction equipment and machines during various phases of the Gas Hills Project are listed in **Table 4.1-3** (U.S. NRC 2004).

The hourly emission rates shown in **Table 4.1-3** are short-term averages of the emission rates used in the modeling to predict short-term impacts (hourly and daily) from construction, operations, and reclamation activities. These maximum emission rates represent the activities that would be most likely to result in pollutant concentrations that would potentially violate NAAQS. Modeled impacts are discussed in the following section. Hourly emission rates are used to determine hourly and daily concentrations of air pollutants (impacts), which are compared to the NAAQS that are expressed as 1-hour (SO_2 and NO_2), 8-hour (CO), and 24-hour (PM) average concentrations. For more discussion on air quality modeling, see **Appendix E**.

Table 4.1-2 Emissions Sources for Project Construction and Operation

Period	Stage/Purpose	Equipment Name	Model No./Capacity	No. of Units	Freq. of Operation	Duration of Operation
Construction	Initial Construction/ Wellfield Road Construction	Scraper	CAT 651	1	8 hrs/day, 5 days/wk	2 months
		Bulldozer	CAT D9	1	8 hrs/day, 5 days/wk	2 months
		Motor Grader	JD 570B	1	8 hrs/day, 5 days/wk	2 months
	Initial Construction/Well	Truck-mounted Rotary Drilling Rig, Semi-type Diesel Tractor Truck	GD1500	14	8 hrs/day, 5 days/wk	12 mo/yr
		Pump Pulling Vehicle	1-ton gas or diesel	2	8 hrs/day, 5 days/wk	12 mo/yr
		Motor Grader	JD 570B	1	8 hrs/day, 5 days/wk	3 mo/yr
		Backhoe	JD 710D	3	8 hrs/day, 5 days/wk	12 mo/yr
		Forklift	Case 586D	2	8 hrs/day, 5 days/wk	12 mo/yr
		Cementer	6 Cylinder Gas.	4	8 hrs/day, 5 days/wk	12 mo/yr
		Light-duty Truck	-	8 - 10	8 hrs/day, 7 days/wk	12 mo/yr
		Heavy-duty Water Truck	1500 gal	4 - 8	8 hrs/day, 7 days/wk	12 mo/yr

Table 4.1-2 Emissions Sources for Project Construction and Operation

Period	Stage/Purpose	Equipment Name	Model No./Capacity	No. of Units	Freq. of Operation	Duration of Operation
Construction (cont.)	Construction Material Transport	Heavy-duty Truck – Material Transport	Diesel Semi-Tractor and Trailer	1	1 trip/day	2 mo/yr
	Commuting	Light-duty Vehicle from Riverton	Diesel Pickup/ passenger car	15	1 trip/day	6 mo/yr
		Light-duty Vehicle from Casper		15	1 trip/day	6 mo/yr
Operation	Satellite Facility	Natural Gas- or Propane-fired Heater	0.4-0.5x106 Btu/hr[a]	6	24 hrs/day	6 mo/yr
	Product Transport	Truck to Highland Uranium Project site via Riverton	Diesel Semi-Tractor and Trailer	2	1 trip/day	12 mo/yr
	Commuting	Light-duty Vehicle from Riverton	Pickup/passenger car	15-18	1 trip/day	12 mo/yr
		Light-duty Vehicle from Casper	-	10-12	1 trip/day	12 mo/yr
Decommissioning/ Reclamation	Reclamation	Scraper	CAT 651	1	2 x 8 hr shift/ day*	2 – 3 yrs
		Motor Grader	JD 570B	1	2 x 8 hr shift/ day*	2 – 3 yrs
		Backhoe	CAT 245	2	2 x 8 hr shift/ day*	2 – 3 yrs
		Heavy-duty Truck	Diesel	3	2 x 8 hr shift/ day*	2 – 3 yrs
		Light-duty Truck	Pickup	15	2 x 8 hr shift/ day*	2 – 3 yrs
	Commuting	Light-duty Vehicle from Riverton	Pickup/pass. car	10	1 trip/day	2 – 3 yrs
		Light-duty Vehicle from Casper	-	10	1 trip/day	2 – 3 yrs

[a] Btu/hr – British thermal units per hour

Source: U.S. NRC 2004.

Table 4.1-3 Estimated Maximum Hourly Air Pollutant Emissions from Combustion

Maximum Hourly Emission Rate (pounds/hour)			
Pollutant	**Construction**	**Operations**	**Decommissioning/ Reclamation**
SO_2	1.9	2.9	1.0
NO_X	28.5	43.6	15.1
CO	6.1	9.4	3.2
VOC	2.3	3.5	1.0
PM[a]	2.0	3.1	1.1

[a] Emissions of PM from combustion sources are estimated to be identical for PM_{10}, and $PM_{2.5}$.

4.1.2.2 Criteria Pollutant Impacts

Assumptions

A generally accepted method of estimating fugitive dust emissions is to use a typical construction project. The average daily fugitive dust emissions for a typical construction project are estimated to be 1.2 tons PM_{10} per acre per month for construction activities (USEPA 1995). Use of this value is a generally accepted approach for impact analysis and is conservative, since Project construction would not involve demolition of existing structures and other activities with the potential to result in high short-term fugitive dust emissions.

Each truck was modeled as a source of both dust and combustion emissions. The source of dust emissions is the truck wheel, but for the purposes of modeling, dimensions of 5.6 meters lateral and 1.5 meters vertical were set. This is a very conservative approach since all of the emissions start in a relatively small volume. The generic road segment used estimated a silt content of 5.1 percent and moisture content of 2.4 percent.

Analysis Approach

Screening dispersion modeling was performed to assess potential PM_{10} impacts of fugitive dust from disturbed areas during construction. Air modeling was performed using the USEPA screening model; SCREEN3. SCREEN3 is a single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources. SCREEN3 is a screening version of the Industrial Source Complex 3 model (ISC3). For this study, SCREEN3 model version 96043 was used to evaluate impacts from fugitive dust. The GHPA was modeled as an area source using full meteorology (the case meteorological data set as defined in the SCREEN3 model that includes low wind speed and a highly stable atmosphere) as well as regulatory model default values for mixing heights (heights of inversion layers) and anemometer (device for measuring wind speed) heights. Impacts that would be representative of activities in the analysis area were assessed at a distance of 50 meters from the disturbance. See **Appendix E** for further discussion on modeling using SCREEN3.

Screening dispersion modeling also was performed using SCREEN3 to assess combustion emissions from truck and drill rig engines and fugitive dust emissions from dirt roads, disturbed ground, and all construction activities. Trucks were modeled as volume sources using full meteorology, as well as regulatory model default values for mixing heights and anemometer heights. Impacts from roads were assessed at a distance of 10 meters to 5,000 meters from roads in the analysis area, and impacts that are representative of emissions from construction were assessed at a distance of 50 meters from the disturbance. Emissions from internal combustion engines were calculated from emissions factors based on engine rated horsepower. Drill rig engines were assumed to have the same horsepower rating as

heavy truck engines; therefore, emission rates from both types of engines were assumed to be the same.

Impact Conclusions

Estimated emissions would result in minor short-term impacts on local air quality that would be restricted to the construction period. The construction impacts would diminish as a result of reclamation activities that would continue for 2 to 3 years after construction was completed and disturbed areas were reclaimed. Vehicular exhaust and crank case emissions from gasoline and diesel drivers would comply with applicable USEPA mobile emission regulations (40 CFR 85). BMPs related to air quality, including applicant-committed measures listed in Section 2.3.9, Applicant-committed Environmental Protection Measures, would minimize impacts, and include:

- All disturbed mine unit well, pipeline, and utility trench acreage would be reclaimed and revegetated as soon as possible after construction has been completed.
- Site speed limits of 40 mph on primary roads, 30 mph on secondary roads, and 10 mph on 2-track roads would be implemented to reduce generation of dust.

Concentrations of PM_{10} estimated based on the conservative screening level dispersion modeling analysis for the Proposed Action are shown in **Table 4.1-4** and indicate that impacts due to fugitive dust emissions from roads and disturbed areas during Project construction and operation would represent approximately 1 percent of the direct impacts allowable under NAAQS. Maximum combined impact and background would be less than 20 percent of the air quality standard.

Table 4.1-4 Maximum SCREEN3 Model Results for Construction Fugitive Dust

Pollutant	Averaging Time	Impact ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Percent of NAAQS
PM_{10}	24-hour	0.8	10.2	11.0	150	7
	Annual	0.2	9	9.2	50	18
$PM_{2.5}$	24-hour	0.2	6.9	7.1	35	20
	Annual	0.1	2.6	2.7	15	17

Note: Based on a particulate emissions rate of 1.2 tons/acre/month for a typical construction project (USEPA 1995).

Results of the conservative screening level dispersion modeling analysis for engines and roads during the life of the Project for the Proposed Action are shown in **Tables 4.1-5** and **4.1-6**, and indicate that the impacts from engines and road traffic would be well within the NAAQS and WAAQS.

Modeling results indicate that these activities would result in impacts that are well within allowable concentrations under NAAQS.

Air Quality Related Values

Federal land managers responsible for managing Class I areas, such as wilderness areas and national parks, are concerned with potential impacts from nearby activities on air quality related values (AQRVs) such as, visibility impairment, ozone effects on vegetation, and effects of pollutant deposition on soils and surface waters. For each of these areas of concern, federal land managers' air quality guidance recommends that a screening test be applied for proposed sources greater than 50 km from a Class I area to determine whether or not any further analysis is necessary. No Class I areas are located less than 50 km from the GHPA. The screening test considers a source located greater than 50 km from a

Table 4.1-5 Maximum SCREEN3 Model Results for Combustion Emissions from Heavy Vehicle Engines

Pollutant	Averaging Time	Impact ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Percent of NAAQS
NO_2	1-hour	12.1	NA	12.1	188	6.4
	Annual	0.5	NA	0.5	100	0.5
CO	1-hour	3.5	NA	3.5	40,000	0.0
	8-hour	2.5	NA	2.5	10,000	0.0
SO_2	1-hour	1.1	NA	1.1	196	0.6
	3-hour	1.1	NA	1.1	700	0.2
SO_2	24-hour	0.5	NA	0.5	365	0.1
	Annual	0.0	NA	0.0	80	0.0
PM_{10}	24-hr	0.5	10.2	10.7	150	7.1
	Annual	0.0	9.0	9.0	50	18.0
$PM_{2.5}$	24-hr	0.1	6.9	7.1	35	20.1
	Annual	0.0	2.6	2.6	15	17.2

Note: Values shown in this table are associated with emissions for 1 500-HP truck.

Table 4.1-6 Maximum SCREEN3 Model Results for Fugitive Dust from Roads During All Project Phases Compared to NAAQS

Pollutant	Averaging Time	Impact ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Percent of NAAQS
PM_{10}	24-hour	39.9	10.2	50.1	150	33.4
	Annual	4.0	9	13.0	50	25.9
$PM_{2.5}$	24-hour	4.0	6.9	10.9	35	31.2
	Annual	0.4	2.6	3.0	15	19.9

Note: Values shown in this table are associated with fugitive dust from unpaved roads due to a 20-ton truck traveling 30 miles an hour, and are based on a calculated rate of particulate emissions. **See Appendix E** for the method for calculating emission rates.

Class I area to have negligible impacts with respect to Class I AQRVs if its total SO_2, NO_X, PM_{10}, and sulfuric acid (H_2SO_4) annual emissions (in tons per year, based on 24-hour maximum allowable emissions), divided by the distance (in km) from the Class I area (Q/D ratio) is 10 or less. Based on their guidance, federal land managers would not request any further Class I AQRV impact analyses from such sources as impacts are anticipated to be negligible (USFS 2010).

The Project would not emit H_2SO_4; Project annual emissions of SO_2, NO_x, and PM_{10} are used to derive the potential AQRV impacts as shown in **Table 4.1-7**. This approach provides a conservative analysis of potential impacts to Class I areas since it includes the pollutants of interest to the federal land managers, and is calculated using the highest 24-hour emission rates as if those highest emissions occurred every hour of the day for a full year.

Table 4.1-7 Estimated Maximum Hourly Air Pollutant Emissions from Project Activities

Maximum Hourly Emission Rate (tpy)[a]			
Pollutant	**Construction**	**Operations**	**Decommissioning/ Reclamation**
SO_2	3.5	4.2	0.6
NO_X	52.3	26.1	8.7
PM	3.7	1.9	0.6
Total	**59.5**	**32.2**	**9.9**

[a] Annual emissions (tpy) are based on the potential to emit at the highest hourly rates and conservatively assumes 8,760 hours of engine operation per year. The number and type of engine used for each Project activity is listed in **Table 4.1-2**.

Construction activities would produce much higher engine emissions than operation or reclamation. The number of hours that engines would operate during reclamation would be similar to hours of operation during construction; however, these hours would occur over a longer time period than for construction. Because fewer engines would operate at any point in time, emissions would be lower.

The nearest Class I area is the Bridger Wilderness located about 80 miles (128 km) west of the project area. The Q/D ratio test is calculated based on 144.8 tpy total emissions divided by 128 km resulting in a ratio of 1.1, which is well below 10; therefore, impacts to AQRVs from the Project are anticipated to be negligible and no further AQRV analysis is required.

Hazardous Air Pollutants (HAPs)

HAPs are air toxins that pose the greatest threat to human health. HAP emission rates for each pollutant are below 1 tpy, and the aggregate levels of all HAPs emissions also are less than 1 tpy. **Table 4.1-8** lists the HAPs emitted during each phase of the Project.

Table 4.1-8 Hazardous Air Pollutant Emissions (tpy)

Pollutant	Construction	Operation	Reclamation
Benzene	1.95×10^{-02}	9.77×10^{-03}	1.69×10^{-03}
Toluene	8.56×10^{-03}	4.28×10^{-03}	7.41×10^{-04}
Xylenes	5.97×10^{-03}	2.98×10^{-03}	5.16×10^{-04}
Aceteldahyde	1.61×10^{-02}	8.03×10^{-03}	1.39×10^{-03}
Formaldehyde	2.47×10^{-02}	1.24×10^{-02}	2.14×10^{-03}
Propylene	5.40×10^{-02}	2.70×10^{-02}	4.67×10^{-03}

Note: Includes the number and type of engine used for each Project activity listed in **Table 4.1-2**.

4.1.2.3 Greenhouse Gases

Annual emissions of GHGs CO_2e from construction and operations sources are directly related to the consumption of fuels (combustion). Purchased power contributing to GHG emissions at the power plants that furnish power to the grid supplying power to the Project are considered in the cumulative impact analysis (Chapter 5.0). **Table 4.1-9** shows the estimated GHG emissions for the Project from direct combustion of fossil fuels, dominated by diesel, and includes natural gas used for process heating.

Table 4.1-9 Greenhouse Gas Production under the Proposed Action

Case	Diesel Consumption (gallons)	Natural Gas Usage (therms)	Power Consumption (megawatt/ hours/year)	Diesel-related GHG (tpy)	Natural Gas-related GHG (tpy)	Total GHG (tpy)
				CO_2e	CO_2e	CO_2e
Proposed Action (stationary sources)	0	546,942	9,746	0	3,014	3,014
Proposed Action (mobile sources)	19,746,935	--	0	219,191	--	219,191
Proposed Action Total	**19,746,935**	**546,942**	**9,746**	**219,191**	**3,014**	**222,205**

Note: Conservatively based on maximum fuel consumption within the GHPA provided by Cameco.

Mitigation

Because impacts to air quality above the NAAQS would not be anticipated, no additional mitigation measures to avoid, minimize, or mitigate impacts would be required.

Residual Impacts

No impacts to air quality above the NAAQS would be anticipated from the Project. Because no additional mitigation has been applied, the residual impacts are the same as those described above.

4.1.3 Resource Protection Alternative

4.1.3.1 Pollutant Emissions

The RPA would involve the same level of fuel combustion and fugitive dust emissions as the Proposed Action Alternative with the exception that diesel fuel use would be reduced by approximately 2 percent due to a reduction in truck trips to the Smith Ranch-Highland facility.

4.1.3.2 Criteria Pollutant Impacts

Impacts from pollutant emissions under the RPA would be the same as described for the Proposed Action except that the number of truck trips would be reduced to 122 annual trips to the Smith Ranch-Highland facility as opposed to 325 annual trips under the Proposed Action. This reduction would result in a 2 percent reduction in emissions of criteria pollutants from diesel combustion relative to the Proposed Action. Therefore, activities conducted under the RPA would result in impacts that are well within allowable concentrations under the NAAQS.

4.1.3.3 Greenhouse Gases

Impacts from GHGs under the RPA would be the same as described for the Proposed Action except that the number of truck trips would be reduced to 122 annual trips to the Smith Ranch-Highland facility as opposed to 325 annual trips under the Proposed Action. This reduction would result in approximately a 2 percent reduction in the diesel consumed for the Project, and would result in a reduction of about 5,000 tpy, or about 2 percent, of GHGs from product transport relative to the Proposed Action.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No residual impacts would be anticipated.

4.1.4 Irreversible and Irretrievable Commitment of Resources

Air quality impacts in the GHPA would be reversible. Once Project activities are completed the air quality would return to its pre-Project state. Since no exceedences of the NAAQS are anticipated for the Project, irretrievable impacts to air quality would not be anticipated.

4.1.5 Relationship between Local Short-term Uses and Long-term Productivity

Construction and operational activities that would occur under the Proposed Action and RPA would produce emissions of PM and criteria air pollutants that would cease after completion of the Project and would not result in continued, long-term impacts to air quality. GHG emissions would likewise cease following completion of the project but the GHGs would remain in the atmosphere over the long-term.

4.2 Cultural Resources and Native American Concerns

For cultural resources and Native American concerns, the analysis area is called the area of potential effect (APE). Under Section 106 of the NHPA, the APE is defined as "those areas in which impacts are planned or are likely to occur. Specifically, the APE is defined as the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. Additionally, the APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (36 CFR 800.16[d])."

Under this regulation, the APE should include:

- All alternative locations for all elements of the Project;
- All locations where the Project may result in disturbance of the ground;
- All locations from which elements of the Project (e.g., processing and waste water disposal facilities, header houses, power lines) may be visible or audible;
- All locations where the Project may result in changes in traffic patterns, land use, public access, etc.; and
- All areas where there may be indirect as well as direct effects.

For purposes of this EIS analysis, the APE for direct and indirect effects encompasses the processing facilities, waste water disposal facilities, roads, header houses, power lines, wells, pipelines, electrical lines, and communication cables within the GHPA, plus access roads outside of the GHPA. For visual effects, the APE encompasses the GHPA, access roads, and areas from which any aspect of the Project is visible. This generally is 3 to 5 miles, or the foreground-middleground distance zone as defined in the VRM manual, but could be more or less depending on the scope of the project and landscape features. Only those historic properties located in the APE were reviewed to determine whether they would be subject to impacts that could affect their eligibility for the NRHP.

Primary issues related to cultural resources and Native American concerns were by BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process, and include:

- Drilling of exploratory boreholes, installation of wells, and construction of associated project facilities that could affect historic properties such as prehistoric or historic archaeological sites, districts, buildings, structures, and objects, and traditional cultural properties (TCPs);
- Previously undiscovered cultural resources, including burials and associated funerary objects, could be discovered and adversely affected during ground-disturbing activities associated with project construction;
- Unauthorized artifact collection and vandalism;
- Introduction of visual or auditory elements that diminish the integrity of a historic property's setting; and
- Potential impacts to Native American properties of traditional religious and cultural importance including TCPs, sacred sites, or other sites that may be of tribal concern.

Potential impacts to cultural resources and Native American concerns were identified based on review of existing literature and site records, as well as the results of past and recent Class III pedestrian inventories conducted within the GHPA and through the Native American Consultation efforts. Potential

effects are quantified where possible. In cases where quantitative data are not available, best professional judgment or qualitative assessments are used to describe impacts.

Section 106 of the NHPA requires that federal agencies consider the potential effect of an undertaking on historic properties and provide the Advisory Council on Historic Preservation an opportunity to comment. Historic property, as defined by the regulations that implement Section 106, means "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the NRHP maintained by the NPS." The term includes properties of traditional religious and cultural importance to any Native American tribe that meet the National Register criteria.

The impact analysis of cultural resources is based on the following assumptions.

- The number of sites that would be impacted by the Project is directly correlated with the degree, nature, and quantity of surface disturbance within the APE.
- Protection of historic properties would occur in accordance with the 2003 PA (as amended in 2012), SHPO consultation requirements, and other federal regulations.
- Places of cultural and religious importance to Native Americans, including TCPs, would be protected in accordance with tribal consultation requirements and other federal regulations.
- The values that render a cultural resource eligible for the NRHP would dictate what type and kind of impacts are of concern.
- Formal consultation with Native American tribes to identify places of cultural and religious importance to the tribes, including TCPs, would take place throughout the NEPA process and up to project completion.

4.2.1 No Action Alternative

Under the No Action Alternative, no uranium mining or corresponding activities would take place within the GHPA. As a result, none of the potential direct impacts to historic properties as identified for the Proposed Action Alternative would occur. Under this alternative the Carol Shop facility, 1 road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres. These activities would occur within previously disturbed areas; therefore, the potential for identifying new cultural resources at these locations would be minimized. Exploratory drilling would continue at the rate of approximately 5 acres a year, and cultural resource clearances would continue to be protected pursuant to 43 CFR 3809.420(b)(8). Indirect impacts such as illegal collecting of artifacts and vandalism would be expected to continue at current levels.

4.2.2 Proposed Action Alternative

4.2.2.1 Impacts on Cultural Resources and Native American Traditional Values

Although effects to historic properties are determined on a site-specific basis with each individual disturbance, certain activities associated with the Proposed Action Alternative would have a greater potential to adversely affect these properties. Activities that could result in direct effects to historic properties include ground-disturbance activities such as installation of surface infrastructure (processing facilities, waste water disposal facilities, roads, header houses, and power lines), as well as subsurface infrastructure (wells, pipelines, electrical lines, and communication cables). These physical impacts could result in the vertical and horizontal displacement of soil containing cultural materials and the resulting loss of integrity and information, and the alteration of a site's setting.

Based on previous and recent archaeological inventories, a total of 78 cultural resources are located within the GHPA. Of these, 23 are eligible for listing on the NRHP and 55 are not eligible. A total of 9 NRHP-eligible sites and 16 ineligible sites are located in proposed disturbance areas and could be directly affected by ground-disturbing activities associated with the Proposed Action Alternative. For

those sites located in proposed disturbance areas, 9 required Native American consultation to determine eligibility, and all were determined to be eligible for listing on the NHRP.

Avoidance would be recommended for the historic properties located within proposed disturbance areas. If avoidance is not feasible, the historic properties would be treated in accordance with a historic properties treatment plan, which is described later in this section. Avoidance also would be recommended for sites of religious or cultural significance to Native American tribes. Appropriate avoidance distances would be determined in consultation with interested tribes. If any sites of religious or cultural significance to Native American tribes cannot be avoided by the recommended distances, mitigation measures would be developed in consultation with interested tribes and incorporated into a historic properties treatment plan.

Potential indirect effects could include vandalism, inadvertent damage, and illegal artifact collection due to increased numbers of people in and increased access to the GHPA. Other potential indirect effects could include the introduction of visual or auditory elements that diminish the integrity of the property's significant historic features, including setting. Portions of the GHPA are visible from a segment of the historic Casper to Lander Road. However, recent archaeological investigations of the road found that the segment had been destroyed by previous disturbance; therefore, the segment is considered a non-contributing segment to the road's overall eligibility (Larson et al. 2012). No visual mitigation measures are necessary for the Casper to Lander Road. Additional areas that could be visually affected by the Project may be identified by interested tribes during the consultation efforts.

The Castle Gardens Rock Art Site is located approximately 8 miles north of the GHPA. Although the site would not be physically or visually impacted by the Project, there is concern that an increase in the numbers of people in the area may increase visitation to the site and consequently increase the potential for vandalism. However, since Project employees would not be living in the Gas Hills areas and the Castle Gardens Road is not proposed as a primary or alternative access route, no indirect effects to the site would be anticipated.

The potential for the discovery of unanticipated archaeological deposits during construction activities exists within proposed disturbance areas and could result in direct effects. Unanticipated discoveries could result in displacement or loss (either complete or partial) of the discovered material. Displacement of archaeological deposits affects the potential to understand the context of the site and limits the ability to extrapolate data regarding prehistoric settlement and subsistence patterns.

In 2003, a PA among the Wyoming SHPO, U.S. NRC (as lead federal agency), BLM and PRI was developed to ensure identified historic properties were appropriately managed and protected during the Gas Hills Uranium Recovery Project (U.S. NRC 2003). On May 22, 2012, the PA was amended to extend the terms of the original 2003 PA, identify Cameco as the Project proponent, and designate the BLM as the lead federal agency to fulfill the requirements of Section 106 of the NHPA. As the lead federal agency, the BLM would ensure that the measures in the amended PA are carried out. The PA, as amended, defines general and specific obligations that would be undertaken to ensure the objectives and requirements of the NHPA would be fulfilled. Additionally, the PA, amended, assigns roles and responsibilities for implementation of the PA, which ensures all interested parties are given an opportunity to comment on the effects of an undertaking to historic properties and any mitigation for such effects.

In accordance with the PA, as amended, in consultation with the Wyoming SHPO and interested tribes, the BLM would determine whether construction of the Project would have an adverse effect on any historic properties. If the BLM determines that a property would be adversely affected, measures to avoid, minimize, or mitigate such effects would be proposed in accordance with the PA. Measures to avoid, minimize, or mitigate effects may include, but would not be limited to, 1 or more of the following:

- Avoidance through changes in the construction or operational design;
- Data recovery, which might include the systematic professional excavation and removal of archaeological resources;
- The use of landscaping or other techniques that would minimize or eliminate visual effects on a site's setting;
- Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey or other agreed upon historic recordation process; or
- Other mitigation determined by the BLM through consultation with the SHPO, interested tribes, and other consulting parties.

The PA, as amended, requires that unavoidable adverse effects to historic properties would be mitigated through implementation of a historic properties treatment plan. The treatment plan would address the historic property adversely affected and set forth means to mitigate the Project's effects. A detailed description of treatment proposed for historic properties or portions of historic properties, as well as the rationale, would be provided in the plan. If data recovery is the preferred treatment option for a site, then the BLM would ensure that the developed treatment is based on an appropriate research design and is reviewed and approved by the BLM, SHPO, interested tribes, and other consulting parties.

As provided in the PA, if any previously unknown archaeological deposits were discovered during Project mining/construction, all activities would cease within 300 feet of the discovery and the BLM would be notified of the find. Steps would be taken to protect the site from vandalism or further damage until the BLM could evaluate the nature of the discovery. Evaluation and mitigation would be carried out by Cameco in consultation with the BLM, SHPO, and interested tribes.

If human remains are inadvertently discovered during project construction/mining activities, Cameco would cease all construction/mining activities within 300 feet in all directions of the human remains. Cameco would immediately notify the appropriate parties as identified in the PA. Human remains and grave goods found on federal land would be treated in accordance with the Native American Graves Protection and Repatriation Act of 1990 and its implementing regulations (43 CFR §10).

Mitigation

Recommended additional measures to avoid, minimize, or mitigate impacts include the following:

CR-1: To minimize unauthorized collecting of archaeological material or vandalism to known archaeological sites, Cameco and their contractors, and all construction personnel, would attend mandatory training and be educated on the significance of cultural resources and the relevant federal regulations intended to protect them.

CR-2: Native American sites including, but not limited to, rock art, cairns (rock piles), and stone circles would be avoided by a minimum of 0.25 mile unless closer activities are approved through completion of consultation with the affected tribes and written permission is given by the BLM-Authorized Officer.

Implementation of mitigation measure CR-1 would reduce, but not eliminate, the potential for unauthorized collecting of archaeological material within the GHPA as a result of increased access and increased numbers of people in the GHPA. Implementation of mitigation measure CR-2 would reduce the potential for direct and visual impacts to sites of tribal importance through appropriate avoidance measures and involvement with affected tribes.

Residual Impacts

The Proposed Action Alternative would result in the loss of cultural resources not eligible for the NRHP. Although these sites would be recorded to BLM standards and the collected information integrated into local and statewide databases, the sites ultimately would be destroyed by project construction. Historic properties identified within proposed disturbance areas would be mitigated in accordance with the PA, as amended, and approved treatment. Although adverse effects to historic properties would be mitigated through implementation of data recovery or other forms of mitigation, some of the cultural values associated with these sites cannot be fully mitigated; therefore, it is anticipated that residual impacts to these resources would occur.

4.2.3 Resource Protection Alternative

Under the RPA there would be 818 acres of surface disturbance compared to 1,315 acres of surface disturbance under the Proposed Action Alternative. The decrease in surface disturbance would reduce the potential to directly impact unknown historic properties that may be buried and discovered during ground-disturbing activities associated with the Project. If previously unknown historic properties or human remains are discovered during ground-disturbing activities associated with the Project, the discovery would be handled as described for the Proposed Action Alternative. Potential impacts to known historic properties would be the same as described for the Proposed Action Alternative. Unavoidable adverse effects to known historic properties would be minimized or mitigated in accordance with the PA.

4.2.3.1 Mitigation

No additional mitigation measures would be required beyond those discussed for the Proposed Action Alternative.

4.2.3.2 Residual Impacts

The types of residual impacts that could occur under the RPA would be the same as described for the Proposed Action. However, under the RPA there would be a reduction in acres of surface disturbance during mine unit construction which potentially could reduce the degree of residual impacts. Total construction disturbance, including Project infrastructure outside the mine units, would decrease from 1,315 acres as detailed in the Proposed Action to 818 acres under the RPA. Total operations disturbance, including Project infrastructure outside the mine units, would decrease from 633 acres as detailed in the proposed action to 317 acres under the RPA (**Table 2.4-1**). This could represent a reduction in potential direct impacts to historic properties within these areas, although this reduction would not necessarily correspond to a reduction in data recovery.

4.2.4 Irreversible and Irretrievable Commitment of Resources

Historic properties could be irreversibly and irretrievably lost if inventory, avoidance, and/or mitigation efforts are not sufficient to identify and protect these properties.

4.2.5 Relationship between Local Short-term Uses and Long-term Productivity

The Project would result in the loss of short-term use and long-term productivity of cultural resources not eligible for the NRHP and located in proposed disturbance areas. For historic properties located in proposed disturbance areas that cannot be avoided, data recovery or other types of mitigation would be conducted prior to project construction. The scientific information obtained through mitigation would be preserved for the long term. However, the property itself ultimately would be lost. There would be a long-term loss of cultural resources due to illegal collecting of artifacts and vandalism associated with human activity in, and access to, the GHPA.

4.3 Geology

This section describes the potential impacts to geological resources from the alternatives, including geologic hazards and mineral resources.

Potential issues associated with geological resources were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process. Issues associated with geologic hazards include the potential of proposed activities to destabilize conditions that could result in the development of hazards from seismicity and landslides within the study area for these hazards. Issues associated with mineral resources included interference with existing mineral extraction operations, reduced access to other mineral resources, and interference with future mineral extraction operations. The study area for impact analysis for geologic hazards and mineral resources is the GHPA.

Analysis of the risk from the Project to geological hazards was performed through reviewing the following.

- The location of active faults based on information available from USGS and WSGS (2006) and discussed in Section 3.3.3.1, Seismic Hazards.
- Ground motion estimates based on recent updates of the USGS seismic hazard mapping by the USGS (Petersen et al. 2008). There are Quaternary faults in the area around the Project which may rupture at any time; however, only those faults with movement in the last 10,000 years are considered to be active as determined by the USGS (2006). The closest potentially active faults are 25 miles to the south as discussed in Section 3.3.3.1, Seismic Hazards.
- Landslide risk information based on data provided on landslide maps of the WSGS (2004) as shown in **Figure 3.3-3** and discussed in Section 3.3.3.2, Landslides.

An assumption used in the analysis of impacts to mineral resources is that there is a low potential for the occurrence of mineral resources other than uranium within the GHPA (BLM 2009a; Stillwell et al. 2009).

4.3.1 No Action Alternative

4.3.1.1 Geologic Hazards

Under the No Action Alternative the proposed in-situ uranium recovery activities and associated surface disturbance would not occur, although the Carol Shop facility and a portion of the existing road would be removed and reclaimed. Therefore, disturbance associated with the Project would not occur on existing landslide deposits or on steep slopes that could lead to instability or slope failure. Continued exploration activities would continue within the GHPA under existing management at a rate of 5 acres or less each year. In addition, no infrastructure would remain to be impacted by ground motion associated with seismic activity.

4.3.1.2 Mineral Resources

Under the No Action Alternative, present management of mineral resources, including exploration drilling, would continue and no effects on access to oil and natural gas or other mineral resources would occur other than the restraints on development under existing management.

4.3.2 Proposed Action Alternative

4.3.2.1 Geologic Hazards

During construction, disturbance of approximately 7.6 acres of existing landslide deposits (**Figure 3.3-3**) would occur in Mine Unit 2, potentially causing instability and slope failure. Given the occurrence of landslide deposits along the Beaver Rim and in other areas within and near the GHPA, there is a

potential for initiation of slope failure and associated landslide movement where construction disturbance occurs on steep slopes regardless of whether existing landslide deposits have been disturbed. During operations, surface disturbance would be reduced through interim reclamation and the risk of landslide movement would likewise be reduced. However, reclamation and decommissioning to remove Project infrastructure would involve re-disturbance of areas impacted during construction which potentially could result in landslide movement.

Seismic hazards are not likely to pose a risk in the GHPA given that the most likely source fault for ground movement is the South Granite Mountains fault zone, which is 25 miles south of the GHPA. Furthermore, seismic hazard maps (Petersen et al. 2008) estimate predicted ground motions in the GHPA to be less than 10 percent of the acceleration of gravity. While a ground motion in this range would be felt by most people, damage would be slight.

Deep disposal of wastewater would be implemented under the Proposed Action as 1 element of the water management plan for the Project. While induced seismic activity has been observed at a few locations associated with deep wastewater disposal wells (most notably at the Rocky Mountain Arsenal near Denver, Colorado, in the 1960s), most of this activity is minor (Nicholson and Wesson 1990) and most disposal wells are operated without induced seismic activity. The risk of induced seismic activity associated with the proposed deep disposal of wastewater is considered to be low.

Mitigation

The following mitigation measures are proposed to avoid, minimize, or mitigate Project-related impacts associated with geologic hazards.

GEO-1: Where surface disturbance is proposed for locations with slopes greater than 25 percent, an engineering plan would be submitted for review by the AO prior to the initiation of surface disturbing activities. The plan would include engineering drawings, geotechnical studies, drainage design, cut and fill estimates, and final reclamation contours to demonstrate mitigation of mass movement potential.

Implementation of this mitigation measure would reduce, but not totally eliminate, landslide risk from construction activities on steep slopes. If no construction occurs on the steep slopes of the escarpment, the probability of a naturally induced landslide is small.

Residual Impacts

Implementation of mitigation measure GEO-1 would not totally eliminate risk from disturbance on slopes greater than 25 percent.

4.3.2.2 Mineral Resources

The Project would have limited to no impact on exploration and development of other mineral resources in the area, including deep disposal of wastewater. The major mineral resources in the area, oil and gas, are considered to have little development potential in the GHPA (Stillwell et al. 2009). Furthermore, there are no current oil and gas leases in the GHPA and the closest current lease is approximately 2.5 miles outside the GHPA. The Project would not be expected to preclude development of other minerals in the area (bentonite, gold, sand, gravel, coal, and jade) since these commodities are not present within the GHPA.

The BLM estimates that approximately 60,000 cubic yards of sand and gravel for Project access roads would be obtained from an off-site location yet to be determined since there is not an adequate supply of this material within the GHPA. This estimated sand and gravel volume would represent a minor impact on the local deposits of this resource.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

Since no additional mitigation measures have been applied, the residual impacts are the same as described above.

4.3.3 Resource Protection Alternative

Potential impacts from geological hazards and impacts to mineral resources associated with the RPA would be the same as for the Proposed Action Alternative.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No additional residual impacts would be anticipated.

4.3.4 Irreversible and Irretrievable Commitment of Resources

Over the 25-year life of the Project, Cameco plans to remove 25 to 62.5 million pounds of uranium (PRI 2009). Removal of the uranium constitutes an irreversible and irretrievable commitment of mineral resources from the GHPA. The removal of 60,000 cubic yards of sand and gravel for use on Project access roads would be an irretrievable commitment of these resources from a source outside the GHPA.

4.3.5 Relationship between Local Short-Term Uses and Long-Term Productivity

Recovery of uranium from the target ore zones permanently would remove this resource for short-term uses and eliminate the long-term productivity of uranium from the GHPA unless deeper mineral reserves are identified in the future. Implementation of the proposed in-situ uranium recovery would not prevent extraction of other mineral resources after completion of the Project.

4.4 Land Use

This section describes potential impacts to land use and land management that could result from the Project. The GHPA is largely comprised of federal lands, with some private and state-owned lands, as described in Section 3.4, Land Use.

Impacts to land use were identified using the assumption that livestock grazing and recreation are the primary existing land uses in the GHPA. Mining is a historical, but not current, existing land use. Impacts to livestock grazing and recreation are fully described in their respective sections (Section 4.5, Livestock Grazing, and Section 4.9, Recreation), and the reader is referred to these sections.

The BLM considered the potential for impacts from the Project to special management areas or areas with special designation. However, given that these lands are located at least 10 miles from the GHPA (Section 3.4, Land Use) there would be no impact from the Project. Therefore, these areas are not discussed further in this document.

4.5 Livestock Grazing

The primary issues associated with livestock grazing resources include direct and indirect impacts associated with the loss of forage, potential impacts to existing water sources and range improvements, and potential impacts to seasonal livestock movement within grazing allotments. Issues associated with livestock grazing due to construction and operation of the Project were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process.

Potential impacts to livestock grazing resources were identified based on the locations of these resources in relation to the proposed surface disturbance. The locations of proposed surface disturbance and potential subsidence areas were compared to the grazing allotment and range improvement locations to determine the acreage lost within each grazing allotment, and which, if any, range improvements would be affected.

The following assumptions were used in the analysis of impacts to livestock grazing resources:

- The installation of fencing to protect processing and mine unit facilities would prevent access to livestock grazing in the mine units during the life of each mine unit. The fencing around the mine units would not include perimeter monitoring wells;
- Surface disturbance and the long-term presence of Project facilities would reduce forage, and therefore would result in the potential suspension or reduction of AUMs, in grazing allotments;
- An increase in the number of roads and vehicular traffic would contribute to difficulties for livestock management and increase the potential for livestock-vehicle collisions; and
- Applicant-committed protection measures (Section 2.3.8, Existing Monitoring Plans) were taken into account in determining impacts.

4.5.1 No Action Alternative

Under the No Action Alternative, the Project would not be approved. Current land use and surface-disturbing activities would continue as currently authorized. Under this alternative the Carol Shop facility, portions of the AML road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres. If successful, reclamation would result in an increase in forage, which would be a minor beneficial impact to livestock grazing. Exploratory drilling would continue at the rate of approximately 5 acres a year. Reclamation of these exploratory sites would be anticipated to occur within the same calendar year as the disturbance. Mining-related activities on BLM-managed lands may not result in over 5 acres of unreclaimed surface disturbance at any time during the life of the NOI filed for each action.

4.5.2 Proposed Action Alternative

Under the Proposed Action, impacts to livestock grazing resources would include a loss of forage and AUMs, limit access to water sources, and interfere with livestock management. At the start of construction, each individual mine unit would be fenced to exclude livestock. Mine units would remain fenced during operation and reclamation. During reclamation, the fence would remain for a period of at least 2 years, or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization. Development and reclamation in each of the 5 mine units would occur in a phased manner with each mine unit taking several years to be constructed. Construction, operation, and reclamation of each mine unit could require several years depending on market and environmental issues; therefore, the discussion of impacts to grazing units conservatively assumes the maximum amount of disturbance. At the beginning and end of the Project, impacts would be less due to the staggered schedule of development and reclamation. Outside of the mine units,

impacts to livestock resources would result from surface-disturbing activities associated with construction and operation of roads, evaporation ponds, aboveground facilities, and overhead power lines.

Short-term impacts are defined as occurring within 3 to 5 years following surface disturbance, while long-term impacts are defined as those lasting longer than 5 years. The majority of the impacts from the Project to livestock grazing would be long-term since fencing of each mine unit during construction, operation, and reclamation would eliminate available forage for livestock. Additional long-term effects from construction and operation activities would result from surface-disturbing activities outside the mine units, increased vehicle traffic, and increased road and utility networks.

Table 4.5-1 identifies the acreage of disturbance per grazing allotment, the number of livestock AUMs affected per allotment, and the percentage of AUMs that would be lost as a result of fencing and surface-disturbing activities under the Proposed Action. The number of AUMs lost was calculated based on an average number of active AUMs per acre for the grazing allotment acreage lost. Surface-disturbing activities associated with construction and operation activities would result in surface disturbance of 1,315 acres on 2 BLM grazing allotments, with the majority of the disturbance occurring in the Gas Hills grazing allotment. No impacts would occur in the Blackjack Ranch and Diamond Springs grazing allotments due to their location on top of Beaver Rim and outside of the areas to be impacted by the Project. Of this disturbance, approximately 195 acres (9 AUMs) of construction disturbance located outside of the mine units would undergo interim reclamation as described in Section 2.3.2.5, Interim Reclamation. This would result in the loss of 1,120 acres (52 AUMs) of available forage due to placement of facilities and fencing of the mine units through the life of the Project.

Table 4.5-1 Impacts to Carrying Capacity by Allotment in the Gas Hills Project Area under the Proposed Action

Grazing Allotment Name	Allotment Disturbance in Project Area (acres)	Active AUMs[a,b] Lost in Project Area (number)	Percent Loss of Total Active AUMs[a,b]
Blackjack Ranch[c]	--	--	--
Diamond Springs[c]	--	--	--
Gas Hills	1,306	62	2
Matador	9	<1	<1
Total	**1,315**	**62**	**--**

[a] An AUM represents the quantity of forage necessary to sustain 1 cow-calf pair or 5 sheep for 1 month.

[b] Projected active AUMs lost and percent active AUM loss were calculated based on a percentage of the stocking rate within the surface disturbance-related impact area compared to the allotment stocking rate as a whole.

[c] The Blackjack Ranch and Diamond Springs grazing allotments are located on top of Beaver Rim, and would not be impacted by surface disturbance associated with the Project.

Fencing the mine units and the linear surface disturbance outside the mine units would result in a loss of forage and AUMs until reclamation is successful and fencing is removed. Access to any surface water resources located within the mine units, especially WCC in Mine Unit 4, also would be limited by the fencing. An increase in the number of roads and traffic could lead to increased mortality and injuries to livestock, and may cause disruptions to livestock management. Construction and operation activities may disrupt livestock management by limiting access to grazing areas and water sources, and restricting or altering livestock movements.

Indirect impacts would include the potential spread of noxious and invasive species, fugitive dust, habitat fragmentation, and the potential conversion of native vegetative communities due to impacts from increased erosion and invasion and spread of noxious and invasive weed species (see Section 4.13, Vegetation).

Long-term impacts to rangelands would be reduced by the implementation of the applicant-committed measures. Final reclamation would occur once mining is complete, and groundwater restoration has been deemed successful in a mine unit (see Section 2.3.5, Mine Unit Restoration and Reclamation, for further description of final reclamation activities). Reclaimed areas would be fenced for a period of at least 2 years or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization. The goal of final reclamation would be to restore the land to a condition that will sustain the pre-mining land use of livestock grazing and wildlife habitat in accordance with WDEQ guidelines. Once reclamation is deemed successful, and the fencing is removed, livestock grazing could return to the mine unit areas. There would be loss of forage and fragmentation of livestock grazing in the mine units for the life of the Project until final reclamation is successful on each mine unit and the fencing is removed. Adherence to the Wyoming BLM Rangeland Health Standards, as described in Section 3.5, Livestock Grazing, would be required during reclamation to return the grazing allotments to the minimal acceptable conditions for rangelands and assist in achieving successful reclamation.

Rangeland Improvements

No known range improvements on BLM grazing allotments would be directly removed or disturbed as a result of surface disturbance activities under the Proposed Action Alternative. Any unidentified range improvements could be impacted by the Project such as potential damage to fences and gates.

Mitigation

The following mitigation measures are proposed to further avoid, minimize, or mitigate Project-related impacts to livestock grazing resources.

GRA-1: Cameco would coordinate annually or more often when necessary with affected livestock operators to discuss: 1) problems encountered during the past grazing season; 2) agreed-upon corrective actions; and 3) planned development and operations during the next grazing season. This meeting would need to occur on a date early enough to allow grazing permittees sufficient time to make decisions and allocate their resources for the upcoming grazing season.

GRA-2: Prior to construction of each mine unit, surveys would be conducted to identify active existing range improvements. Based on the results of these surveys, surface facilities would be located, to the extent practical, 200 meters from existing range improvements. If avoidance is not feasible, range improvements would be relocated to an alternate location per the BLM guidance. Alternate locations would be approved by the landowner.

GRA-3: Damage to livestock and range improvements identified during surveys would be reported as quickly as possible to the BLM and affected livestock operators and corrective action would be taken.

Implementation of GRA-1 would facilitate communication between livestock operators and the applicant, providing livestock operators with the ability to plan their livestock activities around construction operations to minimize impacts. Mitigation measures GRA-2 and GRA-3 would mitigate impacts to livestock, livestock facilities, and range improvements associated with construction and operation activities.

Residual Impacts

Residual impacts to allotments and AUMs under the Proposed Action Alternative would include loss of 1,141 acres of available forage and 53 AUMs over the life of the Project due to fencing of the mine units and placement of facilities. The amount of available forage could be further reduced through the establishment of noxious weed and invasive species individuals or populations, which could remain over the long term regardless of control programs. The amount of available forage near roads also could be

impacted by fugitive dust, making vegetation unpalatable. The increased number of roads could lead to an increased number of vehicle/livestock collisions. There would be no residual impacts to rangeland improvements and facilities.

4.5.3 Resource Protection Alternative

Under the RPA, modifications would be implemented to reduce the surface disturbance of the Project. Surface disturbance would be reduced through the use of the closed loop drilling system which eliminates the excavation of drilling mud pits; the reduced number of evaporation ponds; and annual development planning which would identify procedures to limit surface disturbance to planned areas. The total amount of surface disturbed at 1 time also would be reduced by the addition of construction timing constraints under this alternative through limiting construction of subsequent mine units until successful reclamation was achieved on the mine unit developed 2 prior (e.g., Mine Unit 3 would not be developed until interim reclamation of Mine Unit 1 was shown to make significant progress toward meeting reclamation success criteria).

While surface disturbance would be reduced, the surface of each mine unit still would be fenced during construction, operations, and reclamation. As the mine units still would be fenced under the RPA, the reduction of disturbance within the mine units would not reduce impacts to grazing compared to the Proposed Action. Surface disturbance would be less under the RPA outside the mine units, reducing the amount of available forage that would be lost. **Table 4.5-2** identifies the acreage of disturbance per allotment, the number of livestock AUMs affected per allotment, and the percentage of AUMs that would be lost under the RPA. The number of AUMs lost was calculated based on an average number of active AUMs per acre for the grazing allotment acreage lost. Surface-disturbing activities associated with construction and operation activities would result in surface disturbance of 1,270 acres on 2 BLM grazing allotments, with the majority of the disturbance occurring in the Gas Hills grazing allotment. No impacts would occur in the Blackjack Ranch and Diamond Springs grazing allotments due to their location on top of Beaver Rim and outside of the areas to be impacted by the Project. Of this disturbance, approximately 206 acres (10 AUMs) of construction disturbance located outside of the mine units would be reclaimed under interim reclamation as described in Section 2.3.2.5, Interim Reclamation. This would result in the loss of 1,064 acres (50 AUMs) of available forage due to placement of facilities and the fencing of the mine units through the life of the Project and reclamation period. Impacts to livestock grazing resources under the RPA would be similar as described above for the Proposed Action Alternative, except that fewer acres would be disturbed.

Table 4.5-2 Impacts to Carrying Capacity by Allotment in the Gas Hills Project Area under the Resource Protection Alternative

Grazing Allotment Name	Allotment Disturbance in Project Area (acres)	Active AUMs[a,b] Lost in Project Area (number)	Percent Loss of Total Active AUMs[a,b]
Blackjack Ranch[c]	--	--	--
Diamond Springs[c]	--	--	--
Gas Hills	1261	59	2
Matador	9	<1	<1
Total	**1,270**	**60**	**--**

[a] An AUM represents the quantity of forage necessary to sustain 1 cow-calf pair or 5 sheep for 1 month.

[b] Projected active AUMs lost and percent active AUM loss were calculated based on a percentage of the stocking rate within the surface disturbance-related impact area compared to the allotment stocking rate as a whole.

[c] The Blackjack Ranch and Diamond Springs grazing allotments are located on top of Beaver Rim and would not be impacted by surface disturbance associated with the Project.

Rangeland Improvements

Impacts to range improvements under the RPA would be the same as described under the Proposed Action.

Mitigation

Mitigation measures for livestock grazing would be the same for the RPA as described under the Proposed Action Alternative.

Residual Impacts

Residual impacts would be the same as discussed for the Proposed Action.

4.5.4 Irreversible and Irretrievable Commitment of Resources

The loss of forage from surface disturbances and fencing of mine units would be an irretrievable commitment of resources during the lifetime of the Project for all Action Alternatives. If reclamation is successful, no irreversible commitments are anticipated for livestock grazing resources under any of the action alternatives. The loss of forage under all of the action alternatives would be irreversible if disturbed areas could not be restored to prior land uses due to unsuccessful reclamation, in which case the bond for the Project would not be released.

4.5.5 Relationship between Local Short-term Uses and Long-term Productivity

Short-term uses impacted by the Project would include displacement of livestock from grazing areas and interference with livestock management. Long-term impacts would include the loss of available active AUMs over the lifetime of the Project, and could include the spread and establishment of noxious and invasive weed species. These factors could lead to the long-term loss of available forage and continued reductions in available AUMs until reclamation is deemed successful.

4.6 Noise

The analysis of noise impacts involves estimating anticipated noise levels at sensitive receptors in and near the GHPA under each alternative. Noise sensitive receptors evaluated in this section include historic trails, recreational users, and residences. A discussion of noise impacts on wildlife can be found in Section 4.17, Wildlife and Fisheries. USEPA guidance stipulates that a noise level of 55 dB(A) would constitute an adverse impact at which residential receptors would experience interference and annoyance (USEPA 1974). The distance where most construction equipment produces noise levels at 55 dB(A) is 1,600 feet. Therefore, the analysis area for noise impacts includes the GHPA plus a 1,600-foot buffer.

Noise issues associated with construction and operation of the Project were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process. Issues identified include:

- Impacts to hunters and dispersed recreationists; and
- Impacts to noise sensitive receptors (historic trails and residences).

Direct and indirect impacts were analyzed primarily on the basis of anticipated increases to dB(A) sound levels within the analysis area, determined by analyzing the distance between noise sensitive receptors such as residences and project components. Potential impacts would include disturbance from increased noise to recreationists generated by construction activity and Project operation. Potential impacts to wildlife associated with noise from Project construction and operation are discussed in Section 4.17, Wildlife and Fisheries.

The following assumptions were used for analysis:

- Noise primarily would be generated from within the GHPA and along Project transportation routes; and
- Traffic-related noise can be extrapolated in proportion to projected changes in traffic volume, discussed in Section 4.12, Transportation.

4.6.1 No Action Alternative

No additional noise would be generated within the GHPA by the Project. Noise in the analysis area would continue to consist of existing ambient noise, short-term noise from reclamation activities, facility decommissioning, and exploratory well drilling. Reclamation activities would utilize heavy construction machinery and light vehicles, resulting in noise levels that would potentially range from 74 dB(A) to 85 dB(A). These noise levels typically are experienced within 50 feet of construction equipment (Harris, Miller, Miller, and Hanson [HMMH] 1995). Construction equipment noise levels generally decline at or below 55 dB(A) at a distance of 1,600 feet from the noise source. Noise from reclamation activities would be short-term, typically lasting 1 construction season. Rural ambient noise levels typically are near 40 dB(A) (USEPA 1978).

4.6.2 Proposed Action Alternative

Impacts under the construction phase of the Proposed Action Alternative would include noise from heavy construction machinery and construction activities, as well as light vehicle construction traffic. Noise generated by construction of Project infrastructure and mine units would be expected to occur for 10 to 12 years. Average noise levels for typical construction equipment range from 74 dB(A) for a roller to 85 dB(A) for a bulldozer (HMMH 1995). In general, the dominant noise source from construction equipment is a diesel engine that is continuously operating around a fixed location or with limited movement. This is particularly true if the diesel engine is poorly muffled. Other sources of continuous noise would include field compressors, bulldozers, and backhoes.

Noise levels for typical construction equipment that would likely be used for the Project range between 80 and 90 dB(A) at a distance of 50 feet (15 meters), as shown in **Table 4.6-1**. The anticipated maximum number of machines operating simultaneously average 14 drill rigs. Assuming geometric spreading only (i.e., a decrease of about 6 dB[A] per doubling of distance from a point source), on the basis of the noise levels presented in **Table 4.6-1**, peak estimated noise levels would exceed the USEPA guidelines for residential noise (55 dB[A]) at a distance of approximately 1,600 feet from the noise source (USEPA 1974). Recreational activities, such as hiking and hunting, near the GHPA could be affected by construction-related noise. Potential direct and indirect noise effects to wildlife are discussed in Section 4.17, Wildlife and Fisheries. No impacts to sensitive noise receptors would be anticipated, as no schools, hospitals, or residences are located within 1,600 feet of the GHPA boundary.

Table 4.6-1 Noise Levels at Various Distances from Typical Construction Equipment

Construction Equipment	Noise Level[a] at Distances (dB[A])					
	50 feet	100 feet	200 feet	400 feet	800 feet	1,600 feet
Bulldozer	85	79	73	67	61	55
Concrete Mixer	85	79	73	67	61	55
Concrete Pump	82	76	70	64	58	52
Front-end Loader	85	79	73	67	61	55
Generator	81	75	69	63	57	51
Grader	85	79	73	67	61	55
Shovel	82	76	70	64	58	52
Truck[a]	88	82	76	70	64	58

[a] The equivalent steady-state sound level that contains the same varying sound level during a 1-hour period.

[b] Noise levels for truck mounted drill rigs are expected to be similar.

Source: HMMH 1995.

Impacts from noise during the operations phase of the Proposed Action Alternative primarily would be from project maintenance vehicles and transportation truck traffic. Noise impacts from operations would be anticipated to occur throughout most of the projected 25 year span of the Project and would overlap with construction, reclamation, and decommissioning phases of the Project. Noise from traffic during the operations phase would range from light- to medium or heavy-duty vehicles. Heavy-duty truck traffic would emit noise at the higher end of the noise producing machinery shown in **Table 4.6-1**; however, the overall noise level of continuous site operation from heavy truck traffic would be intermittent. Operations equipment at ISR uranium recovery facilities, such as pumps and compressors, are normally housed within structures, thus limiting the propagation of noise. In conjunction with the existing ambient noise and the lack of noise sensitive receptors, the result would be a negligible impact from noise.

Reclamation and decommissioning activities also would utilize heavy equipment, resulting in noise of similar intensity, but of shorter duration than noise from construction activities. Hence, the impacts from reclamation and decommissioning activities would be less than that for construction activities.

4.6.2.1 Mitigation

Because anticipated impacts to sensitive noise receptors would not be significant, no additional mitigation measures to avoid, minimize, or mitigate impacts would be required.

4.6.2.2 Residual Impacts

No mitigation has been identified, therefore the residual effects are the same as impacts described previously.

4.6.3 Resource Protection Alternative

Under the RPA, trips to the Smith Ranch-Highland facility would be reduced from 325 trips a year to 122 trips a year, which equals a 62 percent reduction from the Proposed Action. Additionally, reclamation activities and associated noise generated would be reduced, resulting in a reduction of disturbance. Although the peak noise level would not be reduced, less frequent vehicle traffic and subsequent travel noise, as well as less reclamation activity, would result in less impact to noise receptors under the RPA than under the Proposed Action.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No residual impacts would be anticipated.

4.6.4 Irreversible and Irretrievable Commitment of Resources

Elevated noise levels, as described above, that would occur in and near the GHPA during Project construction and operation would be an irretrievable impact. However, Project-related noise would be reversible and would cease after the 25-year life of the Project following decommissioning.

4.6.5 Relationship between Local Short-term Uses and Long-term Productivity

There would be no relationship between local short-term uses and long-term productivity. Long-term uses would return once Project operations cease and noise levels return to ambient levels.

4.7 Paleontological Resources

The analysis area for paleontological resources is the GHPA. The Tertiary formations (Split Rock, White River, Wagon Bed, and Wind River formations) that outcrop within the GHPA have been identified by the BLM's PFYC System (Section 3.7, Paleontological Resources) as having a high potential to contain important fossil resources, defined as vertebrate and/or scientifically significant invertebrate fossils. Other formations (Phosphoria, Tensleep Sandstone, Amsden, Madison Limestone, Gallatin Limestone, and Miocene Rocks) are within the GHPA but are unlikely to be affected by the Project and have moderate to low potential for fossil resources.

Potential issues for paleontological resources were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process, and included the potential for loss of important fossil resources due to the following proposed activities or conditions:

- Ground disturbing activities such as clearing, grading, trenching, and foundation excavation;
- Operational and maintenance activities that would require disturbance of previously unaffected areas within the GHPA; and
- Increased access resulting in vandalism or unauthorized collection.

The impact analysis involved the review of existing conditions to determine the probability of the loss of paleontological resources, and the identification of mitigation measures to protect those resources. Assumptions used for the analysis of impacts to paleontological resources include the following:

- Based on the results of the paleontological survey conducted in July-August 2011 (ARCADIS 2011), the potential for important fossil resources is high, especially in the White River Formation, above which much of the proposed disturbance would take place; and
- The GHPA contains areas that previously have been disturbed by prior mining or exploration activities. The likelihood of the discovery of fossils in these areas is just as likely as in undisturbed areas because proposed excavation for pipelines and drilling reserve pits may be below the depth of previous disturbance. Excavation also increases the chances of encountering bedrock, increasing the likelihood of finding important fossils.

4.7.1 No Action Alternative

Under the No Action Alternative, the Project, with associated ground disturbing activities, would not take place. Under this alternative the Carol Shop facility, 1 road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres. Excavation would not occur to depths greater than originally disturbed; therefore, new impacts to paleontological resources would not be anticipated.

The adverse impacts to paleontological resources that would occur under this alternative would be the result of ongoing geological processes and disturbance through unauthorized collecting from accessible outcrops. Such loss of fossil resources would be considered significant, but the protection of the resource would be by measures outside of the scope of this EIS. The discovery of potential fossil resources through the implementation of the Project would not occur.

4.7.2 Proposed Action Alternative

Impacts (destruction or loss of fossils) would occur from construction activities conducted on formations with potential for important scientific fossil resources. Under the Proposed Action Alternative, construction activities would result in the disturbance of the Tertiary formations with high potential for important fossil resources presented in **Table 4.7-1**. Indirect impacts during construction could include

damage or loss of fossil resources due to the unauthorized collection of scientifically important fossils by construction workers or the public due to increased access to fossil localities near construction areas. Adverse impacts to important fossil resources would be long-term and severe since fossils removed or destroyed are lost to science. It is possible that the Project would have the beneficial impact that ground disturbing activities could result in the discovery of important fossil resources.

Table 4.7-1 Acres Disturbed within Geologic Formations with Potential for Fossils (Proposed Project)

Formation-Deposit	PFYC Rating	Acres Disturbed
Split Rock Formation	3	<1
White River Formation	5	189
Wagon Bed Formation	5	580
Wind River Formation	4 to 5	345

Source: BLM 2008.

Mitigation

Because of the high potential for certain formations within the GHPA to yield scientifically important fossil resources, the following mitigation and protection measures are proposed:

PAL-1: Construction and drilling personnel would be instructed about the types of fossils they could encounter and the steps to follow if fossils were uncovered during mine facility construction. Instructions would stress the nonrenewable nature of paleontological resources and that collection or excavation of fossil materials from federal land without a federal permit is illegal.

PAL–2: If suspected fossil materials were uncovered during construction or mud pit excavation, work would stop immediately to allow the AO to assess the situation and determine if additional mitigation measures would be undertaken before further construction or operations could continue.

PAL-3: During construction and installation of wellfields and related facilities, spot checks of spoil piles would be conducted by a qualified paleontological resources monitor. Spot check inspection would involve visually examining any excavated material for bedrock disturbed during excavation. Where bedrock was identified, it would be visually inspected for fossils of any kind. Where no bedrock was identified, no additional inspection would be recommended. If spot checking indicated the presence of important fossils, a representative sample of these fossils would be collected and the data (including standard geologic descriptions) recorded for each locality. In addition, the BLM would require monitoring of certain high potential areas during active construction (not just spot checks).

PAL4: Fossil specimens recovered on BLM lands during monitoring or spot inspections considered of scientific value would be curated into the collections of a museum repository acceptable to the BLM. Specimens would be prepared to the point of identification, identified, and catalogued into the permanent collections of an established institution. Specimens would not be taken from private properties except upon permission of the landowner. A final technical report would be prepared and submitted following completion of construction. The final report would be prepared according to BLM standards.

PAL-5: Prior to the commencement of ground disturbing activities, a high-value locality identified by the recent ARCADIS (2011) surveys (Section 3.7, Paleontological Resources) would be salvaged to assure that the fossils present could be documented and curated.

Mitigation measures PAL-1 and PAL-3 would increase the potential for rapid identification of any exposed fossil material during Project construction. Implementation of mitigation measures PAL-1, PAL-2, and PAL-3 would reduce the extent of loss of any important fossil resources by requiring immediate cessation of work for evaluation and recordation of fossil materials exposed by Project activities. Mitigation measure PAL-4 would ensure legal disposition of any located fossil material. Mitigation measure PAL-5 would be effective in preserving the scientific value of 1 known, high-value locality. Even with implementation of mitigation measure PAL-3, construction monitoring, some scientifically valuable fossils could be disturbed and lost during excavation and grading over the large number of well sites that would be built. As a consequence, there would be a small incremental loss of fossil material that would be offset by material that is recovered and preserved for the purposes of scientific study.

Residual Impacts

The amount of important fossil material lost or undocumented during construction of the Project would be minimized by application of the proposed mitigation measures.

4.7.3 Resource Protection Alternative

Potential adverse impacts to paleontological resources under the RPA would be similar to those described for the Proposed Action Alternative, although the potential for exposing important fossils would be less due to a reduction in surface disturbance (**Table 4.7-2**). Since there would be no excavation of drilling reserve pits, it is possible that fewer fossil resources would be discovered.

Table 4.7-2 Acres Disturbed within Geologic Formations with Potential for Fossils (RPA)

Formation-Deposit	PFYC Rating	Acres Disturbed
Split Rock Formation	3	<1
White River Formation	5	123
Wagon Bed Formation	5	316
Wind River Formation	4 to 5	226

Source: BLM 2008.

Mitigation

Mitigation measures for the RPA would be the same as for the Proposed Action.

Residual Impacts

Residual impacts for the RPA would be the same as for the Proposed Action.

4.7.4 Irreversible and Irretrievable Commitment of Resources

The destruction or loss of scientifically important fossils would be an irreversible and irretrievable commitment of resources. This loss would be offset by the successful recovery and preservation of any fossil resources identified during surface disturbing activities.

4.7.5 Relationship between Local Short-term Uses and Long-term Productivity

Short-term impacts associated with the exposure of any scientifically important fossils from Project construction and operation would not adversely impact the long-term potential for discovery of potential fossil resources in the area.

4.8 Public Health and Safety

This section describes potential impacts to public health and safety, which include potential exposure of the public and workers to radioactivity based on U.S. NRC studies, use and transportation of hazardous materials (as defined in Section 3.8.2.1, Waste Definitions), as well as generation, transportation, and disposal of hazardous waste. The affected environment for hazardous materials includes air, water, soil, and biological resources that potentially could be affected by an accidental release of hazardous materials during transportation to and from the GHPA or during storage and use for the Project. U.S. NRC's study area for direct and indirect impacts for radiological exposure includes the GHPA and a sufficient distance outside the GHPA to include the nearest communities of Jeffrey City and Waltman. The study area for direct and indirect impacts for generation, transportation, and disposal of hazardous materials and solid waste encompasses the GHPA and the major potential transportation route to the Smith Ranch-Highland facility.

The primary issues associated with public health and safety were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process, and include the following:

- Health impacts from current radiological levels within the GHPA, and from any increase in radon emissions from the ISR process;
- Disclosure of the types and amounts of hazardous materials to be used and the types and amounts of solid and radioactive waste that would be generated;
- Storage of hazardous materials, measures for spill containment, and protection of soil and groundwater; and
- Likelihood of a transportation related release of hazardous or radioactive materials and potential impacts of such a release.

Potential exposure to radiation was determined by reviewing available existing information, including the U.S. NRC EAs (U.S. NRC 2009a,b, 2004), and identifying any potential impacts from the Project. The BLM recognizes the U.S. NRC's expertise in, and jurisdiction over, the control and proper use of radiological materials, and therefore does not undertake independent analysis of radiation exposure but relies upon the expertise of the U.S. NRC. Potential impacts from transportation, handling, and storage of hazardous wastes were identified by reviewing current accident rates and regulations, comparing the handling, storage, and transportation methods proposed for the Project, and determining potential impacts.

Impacts to public health and safety were identified using the following assumptions:

- Enclosed buildings would be sufficiently ventilated to protect workers from excessive radon exposure;
- Historical vehicle accident statistics provide a reasonable estimation of future accident frequencies;
- Because WYDOT incident frequencies from the GHPA to Wyoming State Route 136 and from Wyoming Highway 93 to Processing Plant were not available, they were assumed to be nominal, and would not significantly alter accident rates used for this analysis;
- Trucks utilized in the transportation of potentially hazardous materials have a similar accident frequency compared to trucks currently captured by WYDOT data;
- Not every accident would result in the release of potentially hazardous materials from the truck;

- Radioactivity of any solid waste generated by Project construction or operation would be low-level and disposal methods identified in Section 2.3.1.2, Waste Management, would be sufficient; and
- The transportation, storage, use, and disposal of hazardous materials for mine operations would continue for the life of the mine (approximately 25 years). Shipments of uranium-laden material to the Smith Ranch-Highland facility would cease at the end of mining, but hazardous materials (mainly petroleum-based fuel) would still be transported to the site throughout reclamation activities.

4.8.1 No Action Alternative

Under the No Action Alternative, in-situ uranium mining activities would not take place within the GHPA, and there would be no change to public health and safety associated with exposure to radium or traffic incidents beyond currently authorized actions within the GHPA. Under this alternative, the Carol Shop facility, 1 road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres. While some additional increase in traffic incidents could occur in connection with the reclamation of existing disturbance, the resulting adverse impacts to health and safety would likely be minimal. Exploratory drilling would continue at the rate of approximately 5 acres a year. Any radiologically-contaminated waste generated by these activities would be disposed of according to existing permits. Existing levels of radiation as a result of past mining would continue to be monitored according to U.S. NRC regulations.

4.8.2 Proposed Action Alternative

Under the Proposed Action Alternative, Cameco would construct wells, roads, pipelines, evaporation ponds, and surface facilities. The proposed wells, access roads, and ancillary facilities would be constructed on approximately 1,315 acres throughout the GHPA. Of this total disturbance, 1,025 acres would be associated with mine units and monitoring well rings; 209 acres would be associated with access roads, and the remainder of the disturbance would be attributed to a combination of aboveground facilities, pipelines, evaporation ponds, and topsoil piles (**Table 2-1**).

4.8.2.1 Exposure to Radioactive Materials

Potential impacts to the public from exposure to radioactive materials from the Project would occur from increased concentrations of radon or from distribution of airborne radioactive particles relative to current levels. Both of these are discussed in this section. The U.S. NRC (2009 and 2004) evaluated risk of radon exposure to workers and to the general public. The BLM recognizes the U.S. NRC's expertise in, and jurisdiction over, the control and proper use of radiological materials.

<u>Background Radiological Levels</u>

A likely exposure pathway to radiation is from radon gas. In the Gas Hills region, the elevated amounts of naturally occurring uranium results in the formation of radon-222, a radioactive gas. Radon gas is formed through the radioactive decay of uranium. Uranium and radon are ubiquitous in the U.S., although concentrations vary regionally and depend on the amount of uranium present in the soil, rocks, and water (USEPA 2011c). Exposure to elevated levels of radon gas can increase cancer risk. The USEPA indicates that radon gas may be responsible for 21,000 deaths in the U.S. per year (USEPA 2010). Since radon is heavier than air, radon concentrations tend to be most common in confined spaces with limited air flow, such as residential basements during winter months. Regardless of the setting, whether it is residential or industrial, radon gas emissions typically are mitigated by external venting.

As discussed in Section 3.8.1, Exposure to Radioactive Materials, the gamma exposure rates of the GHPA averaged approximately 175 mrem/yr; slightly more than half the equivalent annual dose the average individual in the U.S. receives from all sources of natural radiation, including contributions from

radioactive material in the soil. The following discussion describes impacts the Project could have on these exposure rates.

Radiological Levels from the Project

Radon emission is a function of uranium decay. Mining activities would not create additional radon but could disturb existing radon gas present within the soils. Because the Project is using ISR, the amount of soil disturbance would be less than for open-pit mining and there would be no underground tunnels or shafts. Elevated radon gas concentrations could be a potential issue in enclosed buildings at the site. Radon concentrations would be mitigated by ventilating enclosed work areas to concentrations as low as is reasonably achievable, ideally below the USEPA standard.

The U.S. NRC (2009a, 2004) evaluated risk of radon exposure to workers and the general public. Regarding worker safety and, pursuant to 10 CFR Part 20, the U.S. NRC would require a radiation safety program that contains the basic elements needed to assure that exposures are kept low. Accordingly, an in-plant radiation safety program would be required for the Project. In addition, during routine radiation safety inspections, if U.S. NRC staff observes in-plant industrial safety deficiencies, those identified deficiencies would be brought to the attention of the facility management.

The radiological effects of radon gas release from the wellfields, satellite buildings, and evaporation ponds during both recovery and restoration operations were modeled by U.S. NRC using an approved computer program (U.S. NRC 2004). The model calculated the concentrations of radon at potential receptor locations at 16 compass points of the GHPA site boundary, the nearest residence, and the nearest communities of Jeffrey City and Waltman. The highest estimated dose from radon exposure was 7 mrem/yr at the eastern boundary of the GHPA. This level is low compared to the 100 mrem/yr dose limit in 10 CFR Part 20 for individual members of the public. The U.S. NRC (2004) concluded that impact from radon gas to “individuals and the population around the Gas Hills Project will be negligible” (U.S. NRC 2004).

In addition, Cameco has indicated that it “will maintain a continuous air monitoring program at locations upwind and downwind relative to the permit boundary to ensure compliance with 10 CFRs 20.1301, 20.1302 and 20.1501. The air monitoring program would include passive gamma and radon monitoring devices.” The monitoring by Cameco would be in addition to the monitoring by DOE of the reclaimed and capped tailings to the north of the GHPA, described in Section 3.8.1, Exposure to Radioactive Materials.

The disposal by burial of drilling mud and cuttings in pits associated with each well or boring would not be expected to increase the amount of background activity in the GHPA since the radioactivity would be diluted to a great degree by the matrix of the drilling mud (largely bentonite clay) and low radioactivity soil and rock materials not associated with the ore zones. Covering the pits would limit any radioactivity emanating from the drilling mud to negligible levels.

The U.S. NRC concluded that the radiological impacts to individuals and the local population would be negligible, and their analysis supports that determination. The BLM recognizes the U.S. NRC’s expertise in, and jurisdiction over, the control and proper use of radiological materials.

4.8.2.2 Hazardous Materials and Solid Waste

Non-radioactive hazardous materials would be transported by commercial carriers or vendors in accordance with the requirements of Title 49 of the CFR. Carriers would be licensed and inspected as required by the WYDOT and USDOT. Permits, licenses, and certificates would be the responsibility of the carrier. Title 49, Parts 71 and 171-180, of the CFR requires that all shipments of hazardous substances be properly identified and placarded. Shipping papers must be accessible and must include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, firefighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers.

During construction and operation, hazardous materials, as defined in Section 3.8.2.1, Waste Definitions, would be transported to and stored at the GHPA for use by Project vehicles and in ISR mine processes. **Table 4.8-1** summarizes these materials.

Table 4.8-1 Hazardous Materials used In Uranium Recovery Process

Material	Use	Maximum Quantity Onsite[a]	Deliveries per Year	Amount per Delivery
Sodium Bicarbonate ($NaHCO_3$)	Injection solution make-up complexer	800 short tons	456	20 short tons
Liquid Oxygen (O_2)	Injection solution make-up oxidant	100,000 gallons	252	4,760 gallons
CO_2	Injection solution pH control	30,000 gallons	60	5,000 gallons
Sodium Chloride (NaCl)	Resin strip	250 short tons	144	17 short tons
Sodium Carbonate (Na_2CO_3)	Resin strip	100 short tons	42	20 short tons
Sulfuric Acid (H_2SO_4)	Carbonate elimination and pH control	100 short tons	48	18 short tons
Sodium Hydroxide (NaOH)	Precipitation pH control	10 short tons	3	20 short tons
Hydrogen Peroxide (H_2O_2)	Precipitation agent for uranium peroxide ($UO_4 \cdot 2H_2O$)	8,000 gallons	24	3,600 gallons
Diesel	Equipment Fuel	3,000 gallons	12	3,000 gallons
Gasoline	Equipment Fuel	3,000 gallons	12	3,000 gallons

[a] Short ton = 2,000 pounds.

Response to On-site Releases

Response to all spills of hazardous materials would be implemented according to a Spill Contingency Plan (SCP). The SCP for the Gas Hills Project would be based on the SCP currently in use at the Smith Ranch-Highland facility, and would ensure any spills that occur during transportation and loading/unloading on-site would be cleaned up as soon as possible. Spills exceeding the reportable quantity would be reported to the U.S. NRC, WDEQ, USEPA, National Response Center, BLM, and the county Emergency Response Coordinator. Releases occurring en-route to or from the Project would be the responsibility of the transportation company. Law enforcement and fire protection agencies also could be involved to initially secure a spill site and protect public safety. Hazardous material transporters are required to maintain an emergency response plan which details the appropriate response, treatment, and cleanup for a material spilled onto land or into water.

For on-site spills, the procedures outlined in the SCP would be used to contain chemicals and wellfield fluids. Specific procedures would be developed for other hazardous materials stored and used at the mine. Any cleanup would be followed by appropriate restoration of the disturbed area, which could include replacing removed soil, seeding the area to prevent erosion, and the return of the land to its previous use. A Spill Prevention Control and Countermeasure Plan (SPCCP) would be part of the SCP. A SPCCP is required by regulation to respond to petroleum and fuel spills.

Potential Effects of a Release

The environmental effects of a release would depend on the material released, the quantity released, and the location of the release. Potential releases could include a small amount of diesel fuel spilled during transfer operations at the mine site to the loss of several thousand gallons of diesel fuel or reagent into a riparian drainage. With the exception of WCC, the Project would not operate in the vicinity of a riparian drainage, and therefore, the release of a hazardous material or waste into a sensitive area (such as stream, wetland, or populated area) is unlikely. Depending on the material released, the amount released, and the location of the release, an accident resulting in a release could affect soils, water, biological resources, and human health. The remediation of spills, whether of non-radioactive hazardous material or radioactive material, would be under the jurisdiction of the U.S. NRC, WDEQ, and USEPA; cleanup would be conducted in compliance with those rules to be protective of human health and the environment.

Residual adverse effects from the use of hazardous materials under the Proposed Action would depend on the substance, quantity, timing, location, and response involved in the event of an accidental spill or release. Operation in compliance with applicable regulations and in accordance with the facility's SCP, as well as the prompt cleanup of potential spills and releases, would minimize the potential of residual adverse effects due to accidental spills or releases of hazardous materials. However, certain media, if impacted by spills, may require long-term cleanup remedies.

During the uranium recovery operations, radioactively-contaminated wastes would be generated. Because these wastes pose a potential hazard to the public and workers if not handled and disposed of properly, they would require disposal in approved facilities. **Table 4.8-2** lists wastes that would be expected to be generated on-site. The radioactive waste that would be expected to be generated is referred to as 11e.(2) waste. The AEA, as revised in 1978 and in 2005 by the Energy Policy Act, defines the 11e.(2) waste as a byproduct or "radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material." (U.S. NRC 2011b). Waste defined under 11e.(2) can include tailing or waste produced by the extraction or concentration of uranium or thorium ore. Generally, 11e.(2) waste has low levels of radioactivity.

Table 4.8-2 Wastes that Would be Generated by the Proposed Action

Type of Waste/Disposal Facility	Generating Process	Annual Generation Quantity	Maximum Quantity On-site	Loads Per Year
Radioactive Waste				
Byproduct; 11e.(2) waste/ licensed facility	Uranium processing activities	Approximately 300 cubic yards	Approximately 3 cubic yards	Estimated 20 trucks per year
Solid Waste (non-radioactive)				
Municipal waste/ Class D landfill	Waste generated from daily office and personnel activities	Approximately 5 short tons	Approximately 0.5 short ton	Estimated 12 trucks per year
Drilling fluids/on-site burial in mud pits	Spent drilling fluids	Not determined	Not determined	Not applicable

All hazardous or radioactive waste generated by the Project would be transported to licensed disposal facilities in accordance with applicable federal and state regulations. Non-radioactive solid wastes would be disposed of appropriately depending upon waste type. The risk of transportation of radioactive waste would be low and the same emergency management procedures would apply.

In addition to the wastes listed in **Table 4.8-2**, any equipment meeting the U.S. NRC definition of radioactively-contaminated waste would be removed during final Project reclamation and disposed of in a U.S. NRC-licensed facility. Equipment could include process pipe and equipment, tanks and vessels, ion exchange resin, filter media, and the solid residue and liners from the evaporation ponds. As described previously, the U.S. NRC is the lead regulatory agency with jurisdiction to oversee use and disposal of radiological materials, such as uranium, and would regulate wastes from the Project. The U.S. NRC EA for the Project (U.S. NRC 2004) describes the currently approved disposal methods and locations. Cameco has identified the Denison Mines facility in Blanding, Utah, for disposal of radioactive waste.

The U.S. NRC (2004) concluded that no impacts would occur due to radioactive waste generated by the Project, and the BLM recognizes the U.S. NRC's expertise in, and jurisdiction over, the control and proper use of radiological materials.

4.8.2.3 Transportation of Materials

Carriers involved with the transportation of radioactive materials (resin or waste) would comply with U.S. DOT rules regarding Hazard Category 7 (radioactive material). In the event of an accident involving a truck trailer with uranium-laden material or chemicals, Cameco would implement its Safety, Health, and Environmental Quality (SHEQ) Management System Emergency Systems Volume VIII, which would be based on the existing Smith Ranch-Highland plan (PRI 2011a). The emergency systems provide procedures for responding to a transportation spill, preparedness requirements for transporters, and notification procedures. Cameco also would be prepared to assist in a transportation-related emergency response through a cleanup contractor that would be on 24-hour call.

A release of hazardous materials during transport could have implications for public health and safety. The location of the release would be the primary factor in determining its importance. As shown in **Table 4.8-3**, the conservatively estimated probability of a release of hazardous or radioactive material anywhere along the transportation route is very small; the probability of a release within a populated area is smaller; and the probability of a release involving an injury or fatality is smaller still.

In the event of a trucking accident with the release of potentially hazardous materials, proper implementation of the SHEQ Plan would minimize exposure to the public, emergency response personnel, and Cameco workers. Following an Incident Command Structure, Cameco and its contractors would notify appropriate agencies and emergency response personnel and would respond, monitor, and clean the affected site until the site was considered acceptable. For some types of spills, cleanup criteria are established by agencies and would be met before Cameco's responsibility would end. Consequently, the hazard posed by trucking of the resin and hazardous chemicals poses minimal risk to public health or to the environment. Additionally, WYDOT would respond immediately to hazardous materials accidents to minimize the spread of contaminants. If Cameco did not respond, WYDOT would contract emergency cleanup services and relay the cost to the hauling contractor.

<u>Mitigation</u>

Because of the potential for hazardous material spills to impact riparian areas, the following mitigation and protection measure to avoid, minimize, or mitigate impacts is proposed:

Table 4.8-3 Probability of a Transportation-related Release of Hazardous Materials, Proposed Action

Material	Number of Shipments/ Year[a]	Distance per Shipment (miles)	Total Miles, Life-of-Mine[b]	Incident Rate per Million Miles	Calculated Number of Incidents[c]
Resin	325	142	1,153,750	0.0000005[e]	0.58
Radioactive Waste	20	550	275,000	0.0000005[e]	0.14
H_2SO_4	48	79[d]	94,800	0.0000004[f]	0.04
NaOH	3	79[d]	5,925	0.0000004[f]	0.002

[a] Anticipated number of trips for resin, radioactive waste, SO_4, and NaOH transportation per year, conservatively based on maximum uranium production.

[b] Life-of-Mine: 25 years.

[c] Number of incidents = distance X (incident rate).

[d] Distance from Casper, Wyoming using CR 212 (Gas Hills Road).

[e] Table 25, page 4-13 and Table 37, p 5-6, Battelle (2001), includes accidents and en-route leaks, but not loading/unloading incidents. Accident rate for USDOT Hazard Category 7, Radioactive Material.

[f] Incident rate for USDOT Hazard Category 8, Corrosives, Battelle (2001).

HAZ-1: No fuel or other hazardous material would be stored within 500 feet of a riparian area during construction or operation of the Project. Design features involving proper handling and storage of hazardous materials would be used to minimize accidental spills.

Implementation of HAZ-1 would minimize potential impacts from accidental spills or releases into riparian areas within the GHPA.

Residual Impacts

No significant impacts would be anticipated to public health and safety from radiological materials within the GHPA, from hazardous waste and radiological materials associated with the Project, or from the transportation of hazardous or radiological materials associated with the Project; therefore, residual impacts also would not be anticipated.

4.8.3 Resource Protection Alternative

Impacts from the RPA would be the same as described for the Proposed Action, except drill cuttings would be collected during mine unit construction by utilizing a closed loop drilling system and the subsequent elimination of excavated drilling mud pits, and by restricting disturbance within mine units to planned pathways. Additionally, acres of disturbance would be reduced during operations as a result of a decrease in the number of evaporation ponds. Total construction disturbance, including Project infrastructure outside the mine units, would decrease from 1,315 acres as detailed in the Proposed Action to 818 acres under the RPA. Total operations disturbance, including Project infrastructure outside the mine units, would decrease from 633 acres as detailed in the Proposed Action to 317 acres under the RPA (see **Table 2.4-1**).

Processing uranium-laden resin to yellowcake slurry at the GHPA would reduce the number of shipments of material to 122 annual trips to the Smith Ranch-Highland facility as opposed to 325 annual trips under the Proposed Action. Shipments of H_2SO_4, Na_2CO_3, NaOH, and H_2O_2 would increase by a maximum of 12 trips per year for each material to the GHPA. Rates of waste generation would be similar to the Proposed Action.

4.8.3.1 Exposure to Radioactive Materials

Under the RPA, uranium bound to resin would be eluted and concentrated into yellowcake slurry at the GHPA. Ventilation of enclosed structures, as described under the Proposed Action, would ensure the additional processing would not increase the potential for worker exposure to radon. Exposure to surrounding communities also would not be expected to increase. Because uranium is chemically bound in yellowcake slurry, the potential for exposure to radiation from yellowcake slurry is no greater than from uranium bound to resin. Therefore, impacts to public health and safety from radioactive materials under the RPA would be the same as for the Proposed Action.

4.8.3.2 Hazardous Materials and Solid Waste

With regard to hazardous materials and solid waste, potential impacts under the RPA would be similar, with differences in the types and amounts of chemicals that would be used on-site and a difference in the number of trips of product shipped to the Smith Ranch-Highland facility for processing.

Under the RPA, instead of resin, yellowcake slurry would be transported to the Smith Ranch-Highland facility. In addition to materials and volumes described for the Proposed Action Alternative (**Table 4.8-1**), the creation of yellowcake slurry would require additional chemicals listed in **Table 4.8-4**.

Table 4.8-4 Additional Hazardous Materials to be Used for the Yellowcake Slurry Process for the RPA

Material	Use	Maximum Quantity On-Site[a]	Deliveries per year[b]	Amount per Delivery
H_2SO_4	Carbonate elimination and pH control	100 short tons	12	17.5 short tons
Na_2CO_3	Resin strip	100 short tons	12	20 short tons
NaOH	Precipitation pH control	10 short tons	12	20 short tons
H_2O_2	Precipitation agent for uranium peroxide ($UO_4 \cdot 2H_2O$)	8,000 gallons	12	3,600 gallons

[a] Short ton = 2,000 pounds.

[b] In addition to shipments listed in **Table 4.8-1**.

Compared with the Proposed Action Alternative, the amount of hazardous materials on-site would increase under the RPA. With proper implementation of the SPCCP, impacts from this additional storage would be the same as described under the Proposed Action.

In addition to the chemicals listed in **Table 4.8-4**, The RPA calls for the use of closed-loop drilling mud systems to eliminate the burial of used drilling fluids and cuttings in pits adjacent to every boring or well. Rather, the waste drilling fluid and drill cuttings would be transported to an approved off-site disposal facility or buried in a common on-site repository to reduce the amount of ground disturbance.

4.8.3.3 Transportation of Materials

Under the RPA, the risks of impacts from the transportation of yellowcake slurry or hazardous materials would be less than for the Proposed Action (**Table 4.8-5**) due to an overall decrease in the number of trips. There would be an increase in the number of trucks transporting H_2SO_4 and H_2O_2 to the GHPA.

Table 4.8-5 Probability of a Transportation-related Release of Hazardous Materials, RPA

Material	Number of Shipments/ Year[a]	Distance per shipment (miles)	Total Miles, Life-of-Mine[b]	Incident Rate per Million Miles	Calculated Number of Incidents[c]
Yellowcake slurry	122	142	433,100	0.0000005[e]	0.21
Radioactive Waste	20	550	275,000	0.0000005[e]	0.14
H_2SO_4	60	79[d]	118,500	0.0000004[f]	0.05
NaOH	15	79[d]	29,625	0.0000004[f]	0.01

[a] Anticipated number of trips for yellowcake slurry, radioactive waste, H_2SO_4, and N_aOH transportation per year, conservatively based on maximum uranium production.

[b] Life-of-Mine: 25 years.

[c] Number of incidents = distance X (incident rate).

[d] Distance from Casper, Wyoming using CR 212 (Gas Hills Road).

[e] Table 25, page 4-13 and Table 37, p 5-6, Battelle (2001), includes accidents and en-route leaks, but not loading/unloading incidents. Accident rate for USDOT Hazard Category 7, Radioactive Material.

[f] Incident rate for USDOT Hazard Category 8, Corrosives, Battelle (2001).

The potential of exposure to radiation from yellowcake slurry is similar to the potential for exposure to radiation from uranium bound to resin. Because the potential for a transportation-related release of uranium is lower under the RPA, and the potential of harm from the material would not be different, potential impacts to human health and safety from this type of release would be less for the RPA than for the Proposed Action.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No residual impacts would be anticipated.

4.8.4 Irreversible and Irretrievable Commitment of Resources

Since increases in radiation within the GHPA are not anticipated above existing levels and spills or releases of hazardous materials would not be anticipated to impact the human environment, there would be no irreversible or irretrievable commitment of resources as a result of the Project.

4.8.5 Relationship between Local Short-term Uses and Long-term Productivity

Based on modeling by the U.S. NRC, the Project would not significantly increase radiation within the GHPA above already existing levels. All radiologically-contaminated material and equipment from the Project, such as structures, piping, and liners or sediment from evaporation ponds would be removed during final reclamation and disposed of at an U.S. NRC-licensed facility. These actions potentially would prevent impacts to the long-term productivity and sustainability of public land resources such as grazing and recreation.

4.9 Recreation

Potential recreational activities in the GHPA primarily would be hunting, hiking, and OHV use. In light of historical uranium mining in the GHPA and the presence of more attractive regional recreational opportunities, the area is not highly sought after for its recreational resources.

Potential issues associated with recreation were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process. Issues associated with recreation include:

- Reduction in dispersed recreation activities such as hunting, hiking, and OHV use from project development;
- Potential effects on recreation activities due to visibility of aboveground structures; and
- Reduction in recreational use of the area due to Project-related traffic.

Due to the limited nature of recreation in the GHPA, recreational use numbers have not been developed, and were unavailable for this analysis. A qualitative assessment was made drawing upon historical recreational uses of the GHPA and the surrounding region.

The impact analysis involved qualitatively assessing the change to recreation opportunities and the environment that supports the opportunities. The analysis of impacts to recreation assumed that aboveground Project facilities would limit access, affect OHV use, and affect hunting quality and opportunities by altering normal travel patterns for vehicles and wildlife.

4.9.1 No Action Alternative

Under the No Action Alternative, in-situ uranium mining activities would not occur and no new facilities would be constructed. Approximately 3 miles of roads within the GHPA would be reclaimed and existing facilities would be decommissioned. Reclamation of 3 miles of roads within the GHPA would, to a small degree, limit recreational access; however, the decommissioning of facilities and subsequent reclamation would open more acreage to recreational activities. Currently, authorized activities would continue, and impacts to recreational uses would not change from current levels.

4.9.2 Proposed Action Alternative

Surface disturbance from Project construction potentially would have minor adverse impacts on recreation activities such as hiking and big game hunting. Construction activities and drilling operations would generate increased noise and traffic primarily during the day, which could temporarily diminish hiking, hunting, and other recreational activities. The presence of additional aboveground facilities could diminish the hunting, wildlife viewing, and OHV experiences by displacing individuals as described in Section 4.17.2, Wildlife and Fisheries, by reducing wildlife habitat, increasing noise, increasing human presence, and creating a more industrialized recreational setting. Impacts to recreational users likely would be minor due to acclimation to historical uranium development within the GHPA. Additionally, the Project would not affect developed recreational facilities or sites; aboveground facilities would be painted with low reflective paints and colors to minimize the visual effects of the Project (further described in Section 4.14.2, Proposed Action Alternative); measures would be implemented to limit impacts to game animals (Section 4.17.2, Wildlife and Fisheries); and other more appealing recreation areas are located in the general vicinity. Long-term impacts would include better access to the GHPA as a result of improved roads, as well as more acreage for recreational use after Project facilities are decommissioned and reclaimed.

Mitigation

Mitigation measures to avoid, minimize, or mitigate impacts to the viewshed are described in Section 4.14.2, Proposed Action, and measures to avoid, minimize, or mitigate impacts to wildlife, and thus the opportunity for wildlife viewing, are described in Section 4.17.2, Proposed Action Alternative.

Residual Impacts

Residual impacts would be similar to those described for the Proposed Action Alternative.

4.9.3 Resource Protection Alternative

Under the RPA, trips to the Smith Ranch-Highland facility would be reduced from 325 trips a year to 122 trips a year. Less vehicle traffic and associated travel noise, as well as a slight reduction in disturbed acreage outside the mine units, would result in less impact to recreation under the RPA than for the Proposed Action. Otherwise, impacts to recreation under the RPA would be the same as for the Proposed Action.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No residual impacts would be anticipated.

4.9.4 Irreversible and Irretrievable Commitment of Resources

Loss and/or incremental reduction of hunting and dispersed recreation opportunities during construction, operations, and reclamation would be an irretrievable loss. This loss would be reversible after Project decommissioning and reclamation activities cease and increased acreage is available for recreational use.

4.9.5 Relationship between Local Short-term Uses and Long-term Productivity

Recreational access would be impacted during the Project development stage as roads would be opened and closed to facilitate construction. Furthermore, hunting and other dispersed recreational opportunities would be impaired in the short term, as would visual aesthetics; however, in the long term, as the area is reclaimed, visual aesthetics, hunting, and other recreational opportunities would be restored to pre-Project levels.

4.10 Socioeconomics

The primary issues related to social and economic values identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process, that could be associated with the Project and alternatives include:

- Effects associated with potential changes in long-term local population, workforce, employment, or earnings;
- Potential demands for housing and public services or infrastructure that would exceed capacities in these systems; and
- Potential effects on public sector fiscal conditions regarding demand for services compared to revenue generated.

The methodology for evaluating impacts to social and economic values included comparing Cameco's estimates of employment, production, and expenditures for the Project to 2010 Census information. Methods used in the assessment of environmental justice are described in detail in Section 4.10.2.8, Environmental Justice.

Assumptions used in evaluating impacts include the following:

- The study area used in this analysis includes Converse, Fremont, and Natrona counties;
- Cameco estimates approximately 85 percent of new workers hired for the Project would be local residents from communities within the study area, and the remaining 15 percent of new hires would relocate to surrounding communities from outside the study area;
- Minimal changes to population, demographic, or other metrics tracked by the census have occurred in Converse, Fremont, and Natrona counties since the 2010 census; and
- All Project activities (construction, operation, and reclamation) would occur within the 25 years between 2013 and 2037, inclusive.

4.10.1 No Action Alternative

Under the No Action Alternative, no uranium mining or associated activities would take place in the GHPA. Cameco could continue exploration drilling under current exploration permits and approvals as authorized by the BLM and the State of Wyoming. Reclamation and closure of the existing exploration facilities would proceed as described in Section 2.2, No Action Alternative, using the process described in Section 2.3.5, Mine Unit Restoration and Reclamation.

Cameco would continue to employ 1 individual for property monitoring and oversight. Payroll, including benefits, would be approximately $80,000 per year, which would have minimal economic effects in the context of the central Wyoming economy. No non-local workers would be anticipated so there would be no additional demands for housing, community facilities and services, or educational services.

No adverse environmental justice effects have been identified for the No Action Alternative because this alternative would not result in significant adverse environmental, economic, or public health effects in the study area. Because there would be no significant effects, no disproportionate effects on minority or low-income populations would occur.

It is assumed that Cameco would continue to pay rent to owners of the small amount of private and business property (approximately 400 acres) within the GHPA under the terms of any ongoing arrangements.

4.10.2 Proposed Action Alternative

Under the Proposed Action Alternative, construction, operation, and reclamation of the Gas Hills Project would be anticipated to occur within the GHPA over a projected 25 years. The following discussion analyzes potential social and economic impacts of Project activities to the surrounding 3 counties.

4.10.2.1 Population and Demography

Anticipated population effects of the Proposed Action are presented in **Table 4.10-1**. The effects include both direct and indirect employment increases that are projected to be very modest in the context of the population of the study area. In-migrating workers and their families would number approximately 47 persons during most years of the anticipated life of the Project. This increase would represent 0.03 percent of the 2010 population of the 3-county study area. The estimated total includes 36 adults and 11 children, 9 that would be school-aged children.

No estimates were made of racial or ethnic characteristics of the in-migrating workers or their families, but with the very small proportional increase in residents generated by the Project, measureable impacts to the racial or ethnic makeup of the study area would not be anticipated.

4.10.2.2 Economy and Employment

Development of the Project would be anticipated to begin in 2013 with uranium production starting in the following year. In the first year, the direct work force would consist of approximately 20 contract workers and 20 Cameco employees (Section 2.3.4, Personnel/Work Force). In the second year, 2014, contract workers would remain at 20, but Cameco employees at Gas Hills would increase to 65, and 7 workers would be added at the Smith Ranch-Highland facility to processing Gas Hills uranium. These employment levels would remain constant for approximately 18 years, through 2031, when Project employment would begin a decline to 40 Cameco workers and no contractors in 2034, the last year of production (**Table 4.10-2**). By the final 3 years of production, much of the work would be devoted to groundwater restoration and surface reclamation activities, which would continue until approximately 2037. The Project would terminate at the end of 2037.

The highest employment levels, occurring in years 2014 through 2029, would represent a modest 1.6 percent increase in 2010 study area employment in the natural resources and mining sector, and a 0.5 percent increase in total non-farm employment in the 3-county study area (**Tables 3.10-3** and **4.10-2**).

Based on this analysis, indirect/induced employment generated by the Project would be projected at approximately 92 additional jobs, raising the total impact to 184 jobs for most of the Project life. Local labor would be expected to meet 85 percent of the direct Project jobs and 90 percent of the indirect/induced jobs, leaving a need for 23 workers from outside the local area. The non-local hires would provide skills not available locally. The total employment impact would represent a 0.9 percent increase over the study area's 2010 total non-farm employment.

The study area unemployment rate is notably lower than the national rate, as are the individual unemployment rates for each of the 3 separate counties. There are an estimated 4,082 unemployed persons in the area (**Table 3.10-4**). This number of unemployed would be more than sufficient to provide the 129 workers anticipated to be hired from the local labor force (Summers 2012). Reducing the number of local unemployed individuals by 129 would lower the area unemployment rate by 0.2 percentage points.

The estimated payroll for Cameco Project employees, including the value of benefits, would be projected at approximately $5.2 million per year during years 2 through 18 of the Project life. This would be equivalent to an average of $80,000 per employee. Assuming processing plant workers and contract

Table 4.10-1 New Project-related Employment, Households, and Population Projections for the Proposed Action

New Project-Related Employment			
	Direct[a]	**Indirect/Induced[b]**	**Total New Employees**
Local	78	83	161
Non-local	14	9	23
Total	**92**	92	**184**
New Project-related Households			
	Direct[c]	**Indirect/Induced[d]**	**Total New Households**
New Non-local Workers	14	9	
Single	4	2	6
Married - 1 Worker	9	3	12
Married - 2 Workers	1	2	3
New Households	**14**	**7**	**21**

New Project-related Population Growth					
		Population[e]			
			Children[f]		**Total Population Growth**
	Households	**Adults**	**School-Age**	**Other**	
Single Households	6	6	0	0	6
Married Households	15	30	9	2	41
Total	**21**	**36**	**9**	**2**	**47**

[a] Direct workforce was assumed to be 85 percent local, 15 percent non-local.

[b] Indirect and induced employment in the study area was calculated using an employment multiplier of 2.0: the secondary work force was assumed to be 90 percent local and 10 percent non-local. A Cameco economic impact study estimated the statewide multiplier effect at 2.7 (Taylor et al. 2010); the smaller multiplier was employed here for a more conservative estimate of the employment effects in the 3-county study area.

[c] Direct work force was assumed to be 25 percent single or married without families present; 10 percent of the married worker households were assumed to be 2-worker families.

[d] Indirect workforce would provide local services such as drivers, food service, and local government, and was assumed to be 25 percent single or married without families present; half the married worker households were assumed to be 2-worker families.

[e] Population estimates were based on 1 person per single family household and 2.71 persons per married household.

[f] Eighty percent of children were assumed to be of school age (K-12).

Note: Differences in totals are a result of rounding.

Table 4.10-2 Gas Hills Project Employment by Year

Employees/Year	2013	2014	2019	2024	2029	2032	2033	2034
Cameco Mine Employees	20	65	65	65	65	50	50	40
Cameco Processing Plant Employees	0	7	7	7	7	7	7	7
Contractor Employees	20	20	20	20	20	20	0	0
Total	**40**	**92**	**92**	**92**	**92**	**77**	**47**	**47**

workers would earn a similar amount, payments to these workers would add approximately $2.2 million for a total of $7.4 million annually in direct wages and benefits from the Project. Much of this would be spent locally for items such as food, clothing, fuel, and rent, which would benefit the local economy and generate the "induced" economic activity. Personal incomes generated by the Project would be above the average for the 3-county study area (See **Table 3.10-5**).

Indirect/induced workers supported by Project-related economic activity would be likely to earn somewhat lower average incomes than direct workers. These workers would provide local services such as truck drivers, food service, and local government work, and their earnings also would provide a benefit to the study area economy.

4.10.2.3 Housing

The Project would generate an estimated 21 new households in the study area, creating a demand for a corresponding number of housing units for the life of the Project (**Table 4.10-1**). While the vacancy rates for homeowner units in the study area counties are extremely low, the 2010 census identified a total of over 6,000 vacant housing units in the study area, many of which are likely located in or near Riverton and Casper, the largest cities in the study area. Riverton, in particular, is within reasonable commuting distance of the GHPA; Casper is somewhat farther, but still considered within commuting distance. The number of vacancies in Fremont and Natrona counties, as detailed in **Table 3.10-6**, would be more than sufficient to accommodate the housing demand generated by the Proposed Action; therefore the Gas Hills Project would have minimal effect on the housing market in the study area. Motels, hotels, and campgrounds in the study area provide an ample supply of short-term housing opportunities for new arrivals or for contract workers who might have permanent residences outside the study area, as noted in Section 3.10.4, Housing.

4.10.2.4 Public Facilities and Services

As noted, the Project would be expected to increase the population of the 3-county study area by 0.03 percent. This level of population change would not have a measurable effect on demand for public facilities or services in the 3 counties.

4.10.2.5 Education

The Gas Hills Project would lead to an estimated increase of 7 school-age children in the study area (**Table 4.10-1**). This level of change would have minimal effect on school districts in the study area. Enrollments in most school districts in the study area are below their recent peak levels by substantially more than 7 students (Wyoming Department of Education 2011), which supports the conclusion that there is existing school capacity to accommodate the small Project-related increase.

4.10.2.6 Public Finance

The Gas Hills Project would contribute to public revenues in the study area through mineral severance taxes, county property (ad valorem) taxes, and sales and use taxes. Severance taxes and a portion of county property taxes would be based on the assessed value of Project production. Property taxes also would be assessed on the value of Project property and facilities. Under the Proposed Action, estimated annual production from the Gas Hills Project would range from a low of 158,000 pounds of uranium in the final years of production to a high of 1,473,000 pounds during peak production years. The annual average over 21 years of production would be 895,000 pounds of uranium. There is a 4 percent severance tax on uranium (see Section 3.10.8, Environmental Justice, WDR 2010); Cameco estimated severance taxes would be approximately $1.00 per pound, or an average of $895,000 per year, most of which would accrue to state accounts. A small fraction (8.4 percent in 2011) would be distributed by the state to cities, towns, and counties.

The taxable value per pound of Gas Hills Project uranium production could vary from year to year. For the purposes of this analysis, the value is assumed to be approximately the same as reported for 2010 ($19.08 per pound [WDR 2011]). At this rate, the taxable value of uranium produced for the Project would average $17.1 million per year, and could be as high as $28.1 million in peak production years. The ad valorem tax from this valuation would accrue to Fremont County or Natrona County, depending on which mine unit(s) were in production. The taxable value of the average annual production from the Gas Hills Project would represent a 2.2 percent increase in Fremont County's 2010 total taxable valuation or a 1.7 percent increase in Natrona County's 2010 total taxable valuation (Section 3.10.8, Environmental Justice, and BLM 2008).

The Gas Hills Project would pay sales taxes on materials and equipment purchased in Wyoming for use on the site. The Project also would pay use taxes on materials and equipment purchased outside Wyoming for use in the state. The State of Wyoming collects a 4 percent sales and use tax; Wyoming counties have the option of adding up to an additional 3 percent with voter approval. Converse County and Natrona County have each added 1 percent for a total of 5 percent in those counties. Fremont County has only the 4 percent state tax. Cameco has estimated it would purchase an average of $1.5 million in production supplies annually which would result in sales tax payments of between $62,000 and $77,000, depending on the county. This would be a very small addition to sales tax revenues in the 3 study area counties, which totaled approximately $158 million in fiscal year 2011 (WDR 2011). The proportion of sales tax revenues accruing to the state varies by county from slightly under 55 percent in Natrona and Converse counties to approximately 68 percent in Fremont County.

In addition to sales and use taxes paid directly by Cameco, there would be lesser amounts generated by secondary activities, including contract workers. Purchases by employees for personal use also would contribute additional sales tax revenues to state and county coffers.

4.10.2.7 Social Conditions

With only minimal changes in permanent employment or population expected from the Project, changes in the social structure or traditional lifestyles of study area communities would not be expected. A possible influx of a small number of workers would not noticeably affect the quality of life of people currently living in the area. Transitioning of the Gas Hills Project from exploration and sampling to production activity for approximately 25 years would be expected to support individual lifestyles, but would have little or no effect on the social structure of the community as a whole.

4.10.2.8 Environmental Justice

The USEPA suggests a screening process to identify environmental justice concerns (USEPA 1998), as described in Section 3.10.8, Environmental Justice. The 2-step process addresses the following questions:

- Does the potentially affected community include minority and/or low income populations?
- Are the environmental impacts likely to fall disproportionately on minority and/or low income members of the community and/or a tribal resource?

If the 2-step process indicates that there exists a potential for environmental justice effects to occur, the following were considered in the analysis:

- Whether there exists a potential for disproportionate risk of high and adverse human health or environmental effects;
- Whether communities have been sufficiently involved in the decision-making process; and
- Whether communities currently suffer, or have historically suffered, from environmental and health risks and hazards.

To assess the potential for environmental justice impacts, the socioeconomic characteristics of the study area counties and communities were first analyzed for the presence of minority and/or low-income populations. If minority and/or low-income populations are identified based on the USEPA's Environmental Justice Guidance (USEPA 1998), the Project and alternatives were then evaluated for potential effects that could disproportionately impact any such populations.

As noted in Section 3.10.4, Housing, Fremont County has both a Native American population and a low income population that would be considered "meaningfully greater" in size than the state as a whole, as described in Section 3.10.8.1, Minority Populations, which was selected as the reference geographic area.

The initial analysis indicates that the potential environmental effects of the Proposed Action would not be expected to disproportionately affect any particular population. The area in the immediate vicinity of the Project has no resident population. The nearest residences are a few remote ranches located several miles from the GHPA that have not been identified as minority or low-income in nature. The nearest concentrated residential area is over 22 miles away (approximately 35 miles by road) at the small community of Jeffrey City (2010 population: 58). Larger communities are all farther from the GHPA. Riverton is nearly 50 miles to the west; Casper is 60 miles to the east (approximately 172 miles by road using the preferred transportation route, which is Wyoming State Route 136 to Riverton, and Highways 26 and 20 to Casper). The Native American population is concentrated on the Wind River Reservation. The nearest reservation boundary is approximately 35 miles to the west of the GHPA, although the resident population is located at or beyond Riverton. By the same rationale, there are no concentrations of low income people near the GHPA.

Environmental effects that could occur at a greater distance from the GHPA, such as air quality or traffic effects, would affect the study area's population essentially equally without regard to race, ethnicity, or income level. For example, trucks carrying resin or yellowcake slurry to the Smith Ranch-Highland facility would travel through the Casper area on U.S. Highway 20/26, but would add only a very small increment to the existing traffic volumes on the highway.

Regarding whether "communities have been sufficiently involved in the decision making process", the BLM held 4 public scoping meetings and distributed public notices about the Project through mailings and notices in area newspapers in addition to the formal notice in the *Federal Register*, described in Section 1.5, Public Participation. The BLM has initiated consultation with Native American communities as discussed in more detail in Section 4.2, Cultural Resources and Native American Concerns.

Mitigation

Because significant adverse impacts to economics, social conditions, or environmental justice would not be anticipated, no additional mitigation measures to avoid, minimize, or mitigate impacts would be required.

Residual Impacts

Because no additional mitigation measures would be imposed, residual impacts for the Proposed Action would be the same as the impacts discussed in this section.

4.10.3 Resource Protection Alternative

Social and economic effects from development of the Gas Hills Project under the RPA would differ only slightly from those described for the Proposed Action. The key differences would be employment of an additional 10 workers at the Project for processing resin to slurry, for a total of 102, which would infuse an additional $800,000 into the economy annually, including benefits, for a total of $8.16 million. This increase in direct employment would support employment of an additional estimated 10 indirect/induced workers (**Table 4.10-3**). Percentages of local (85 percent) and non-local (15 percent) direct Project workers are assumed to be the same under this alternative as under the Proposed Action.

The increase in employment would be beneficial to the study area employment and would be similar to what is described in Section 4.10.2.2, Economy and Employment.

The RPA would generate a local population increase of an estimated 53 people, 6 more than the Proposed Action, and an increase of 10 new school-age children instead of 9. It would result in an increase of 24 new households requiring 3 more housing units than the 21 required for the Proposed Action.

All of these effects would be beneficial, but very minor, increases from the estimates of effects for the Proposed Action. The increases in demand for housing, schools and other public facilities and services would remain well within the capacities of the housing market and local service providers to accommodate them.

The increase in jobs and wages above what would occur under the Proposed Action Alternative would result in very minor increases in local sales and use taxes generated by households. It is uncertain to what degree this alternative would affect sales and use taxes relative to the Proposed Action Alternative, but there would be some increase due to the additional equipment required on site. It is assumed that there would be no measurable change in uranium production so there would be no change in mineral severance taxes, but there would be a modest increase in the Fremont County ad valorem property tax base from additional equipment required on the Gas Hills site.

There would be no discernible difference in the effects on social conditions or environmental justice between the RPA and the Proposed Action Alternative.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No additional residual impacts would be anticipated.

Table 4.10-3 New Project-related Employment, Households, and Population Projections for the RPA

New Project-related Employment			
	Direct[a]	**Indirect/Induced[b]**	**Total New Employees**
Local	87	92	179
Non-Local	15	10	25
Total	102	102	204
New Project-related Households			
	Direct[c]	**Indirect/Induced[d]**	**Total New Households**
New Non-local Workers	15	10	
Single	4	3	7
Married - 1 Worker	10	4	14
Married - 2 Workers	1	2	3
New Households	15	9	24

New Project-related Population Growth					
		Population[e]			
			Children[f]		**Total Population Growth**
	Households	**Adults**	**School-Age**	**Other**	
Single Households	7	7	0	0	7
Married Households	17	34	10	2	46
Total	**24**	**41**	**10**	**2**	**53**

[a] Direct work force was assumed to be 85 percent local, 15 percent non-local.

[b] Indirect employment was calculated using an employment multiplier of 2.0; the indirect work force was assumed to be 90 percent local and 10 percent non-local. A Cameco economic impact study estimated the statewide multiplier effect on jobs at 2.7 (Taylor et al. 2010); the smaller multiplier was employed here for a more conservative estimate of the 3-county study area employment benefits.

[c] Direct work force was assumed to be 25 percent single or married without families present; 10 percent of the married worker households were assumed to be 2-worker families.

[d] Indirect work force would provide local services such as drivers, food service, and local government, was assumed to be 25 percent single or married without families present; half the married worker households were assumed to be 2-worker families.

[e] Population estimates were based on 1 person per single family household and 2.71 persons per married household.

[f] Eighty percent of children were assumed to be of school age (K-12).

Note: Differences in totals are a result of rounding.

4.10.4 Irreversible and Irretrievable Commitment of Resources

Labor and capital committed to the Gas Hills Project would generate local economic productivity, including jobs. These effects would be reversible in the event the Project was terminated. Once invested and expended, however, they would not be retrievable.

4.10.5 Relationship between Local Short-term Uses and Long-term Productivity

The short-term use of resources during construction, operation, and reclamation of the Project would result in beneficial impacts in the form of additional local employment and the generation of both private and public revenue. For the most part, this productivity would end upon completion of reclamation activities, although there could be some long-term productivity enhancement from training and experience gained by workers.

4.11 Soils

The impact analysis area for soil resources is the GHPA. Issues related to soil resources as identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process include the following:

- Soil disturbance during construction activities resulting in exposed soils, accelerated soil erosion, sedimentation to nearby waterbodies, and reduced soil productivity;
- Potential for successful reclamation of sensitive soils and soils with physical or chemical reclamation constraints; and
- Potential for soil contamination.

The methodology for evaluating impacts on soil resources involved analyzing soil survey data in relation to the proposed surface disturbance areas. To determine acres of soils disturbed by the Project, the known locations of proposed surface disturbances were overlaid on the NRCS Order 3 soil survey layer in GIS to determine the acreage of soils lost or disturbed using GIS. Temporary impacts to soils are those that are anticipated to be short-term in nature (lasting approximately 3 to 5 years), where after construction the soils would be reclaimed and revegetated back to a productive state. Long-term impacts to soils would be anticipated where surface facilities or long-term access roads would be located for the duration of the Project.

The analysis of the impacts to soil resources is based on the assumption that the Applicant-committed environmental protection measures, including the SWPPP, listed in Section 2.3.8, Existing Monitoring Plans, would be implemented as part of the Project. These proposed measures would reduce or minimize impacts to soil resources when implemented. Additionally, all actions that occur on areas under BLM management would be required to comply with the Lander and Casper RMPs. To minimize construction-related impacts to soil resources, reclamation would be conducted as soon as practical following surface disturbance.

The assumptions used in the analysis of impacts to soils are discussed below.

- Surface disturbance from construction would modify soils by disrupting soil stability, changing vegetative cover that can reduce nutrient recycling, damage biological crusts, decrease productivity, and increase compaction.
- When surface disturbance occurs on highly erodible soils, the potential for accelerated erosion is greater than on less erodible soils. Sensitive soils would incur greater adverse impacts from surface-disturbing activities than non-sensitive soils. Sensitive soils include those that are highly erodible, have a high pH, high salinity or sodicity, have a high clay content, or have a LRP. To be effective on highly erodible soils, more extensive BMPs and more aggressive maintenance techniques than those commonly used are often required.
- Erosion from disturbed areas would be minimal once vegetation is reestablished. Successful establishment of vegetation generally takes a minimum of 3-5 years, depending on soil and precipitation, and requires monitoring during this time.
- The risk of erosion control failure is greater on highly erodible soils than on less erodible soils, because the potential for accelerated erosion is greater. To be effective on highly erodible soils, more extensive erosion controls and more aggressive maintenance techniques than those commonly used are often required.
- Operating motorized vehicles on moist soils, especially heavy equipment, is likely to cause compaction of the surface layer, which could increase runoff, decrease infiltration and aeration, and reduce soil productivity by making it more difficult for plant roots to establish or obtain soil moisture and nutrients.

4.11.1 No Action Alternative

Under the No Action Alternative, the Project would not be developed and associated impacts to soils from construction and operation would not occur. Current land use and surface-disturbing activities would continue as currently authorized. Under this alternative the Carol Shop facility, 1 road, and previously disturbed land associated with existing topsoil stockpiles would be reclaimed, resulting in the reclamation of approximately 40 acres of existing disturbance (Section 2.2, No Action Alternative). Reclamation of these disturbances would result in a net benefit to soil resources. Exploratory drilling would continue at the rate of approximately 5 acres a year and would comply with the standards under the 43 CFR 3809.320, surface management regulations; disturbance would be reclaimed within 1 calendar year. Impacts to soils from exploratory drilling would result in short-term impacts to soils while impacts from reclamation of existing infrastructure would provide the benefit of reducing current surface disturbance. Activities authorized under the 3809 surface management regulations (43 CFR 3809.21 and 3809.301 through 3809.336) may not result in over 5 acres of unreclaimed surface disturbance at any time during the life of the NOI filed for each action. Reclamation of these sites would be anticipated to occur within the same calendar year as the disturbance.

Natural and anthropogenic actions such as erosion, fire, recreation, and grazing would continue to impact soil resources at present levels in the analysis area.

4.11.2 Proposed Action Alternative

4.11.2.1 Construction

The following impact analysis focuses on soil resources that could be affected by construction, operation, and decommissioning of the Project. The methodology for evaluating impacts on soil resources involved analyzing soil survey data in relation to the proposed surface disturbance areas. To determine acres of soils disturbed by the Project, the known locations of proposed surface disturbances were overlaid on the NRCS SSURGO Order 3 soil survey layer to determine the acreage of soils and their limitations. Mitigation measures were developed for identified impacts that exceed the significance thresholds, described above, to mitigate or reduce impacts below significant. These mitigation measures follow the impact analyses.

The Project would result in approximately 1,315 acres of new disturbance to soils. **Table 4.11-1** provides a summary of disturbance area soil characteristics. **Figures 3.11-1** through **3.11-4** illustrate the occurrence of important soil characteristics in the GHPA. Within the mine units, construction would include: delineation drilling; installation of injection, production and monitoring wells; installation of pipelines; and construction of header houses and roads to header houses. Under this alternative, all of the soils within the mine units would be disturbed to some degree by construction. Disturbance would be sequenced; therefore, all of the disturbance within the mine unit would not occur at once.

Table 4.11-1 Disturbance Area Soil Limitation for the Proposed Action (acres)

Type of Disturbance	Water Erodible	Compaction Prone[a]	LRP[b]	Shallow Bedrock[c]	Stony Rocky
Process Water Pipeline	2	2	2	0	1
Roads with Utilities Construction ROW	76	31	60	0	23
Mine Unit 1	60	38	46	0	19
Mine Unit 2	201	13	173	0	37
Mine Unit 3	53	5	51	0	2
Mine Unit 4	169	20	23	9	133

Table 4.11-1 Disturbance Area Soil Limitation for the Proposed Action (acres)

Type of Disturbance	Water Erodible	Compaction Prone[a]	LRP[b]	Shallow Bedrock[c]	Stony Rocky
Mine Unit 5	25	3	4	0	6
Ponds, Drainage Diversion, Runoff Control Berm	11	8	8	0	5
Satellite Building West	3	2	2	0	1
Satellite Building Central	3	2	2	0	1
Topsoil Piles	1	1	1	0	0
Mine Unit 1 Monitoring Well Ring	5	2	4	0	1
Mine Unit 2 Monitoring Well Ring	4	1	4	0	1
Mine Unit 3 Monitoring Well Ring	6	1	6	0	0
Mine Unit 4 Monitoring Well Ring	5	1	1	0	4
Mine Unit 5 Monitoring Well Ring	2	0	0	0	0
Total	**626**	**130**	**387**	**9**	**234**

[a] These soils have 28 percent or more clay within the top 20 inches of soil.

[b] Limited reclamation potential.

[c] Lithic Bedrock 60 inches or less form the soil surface.

Source: USDA-NRCS 2011.

Soil compaction would occur from the movement of heavy equipment and vehicles during construction activities. An increase in bulk density and a reduction in soil porosity would directly correspond with the number of passes made by vehicles and construction equipment. Compaction would increase in depth on deep clayey soils and moist or saturated soils. Approximately 130 acres of compaction prone soils are located within the proposed disturbance areas.

Cameco is proposing to grade and level the soils to construct wells and associated facilities, with the greatest level of effort required in more steeply sloping areas. Topsoil would be salvaged at the well houses and associated facilities prior to any grading or leveling. Drilling pits also would have topsoil salvaged separately from subsoil. During construction, the remaining soil profiles would be mixed with a corresponding loss of soil structure. This could potentially mix deeper subsoils that are chemically unsuitable for revegetation with more suitable subsoils closer to the surface which could affect revegetation efforts during reclamation.

The potential for erosion and sedimentation would increase through the loss of vegetation cover and soil structure as compared to an undisturbed state. Approximately 626 acres of water erodible soils occur in the proposed disturbance areas (as shown in **Table 4.11-1**). Surface disturbance of water erodible soils, specifically those on steep slopes of 25 percent or more, would result in accelerated runoff and erosion. **Table 4.11-2** provides the acres of steep slopes within the mine units and GHPA. **Figure 3.11-4** illustrates steep slopes within the GHPA. Steep slopes would be a concern in Mine Units 2, 3, and 4. Mine Units 2 and 4 have the greatest potential for soil loss due to a high acreage of erodible soils (**Table 4.11-1**). As part of the SWPPP, Cameco has committed to minimize erosion impacts through the use of erosion control and channel stabilizing measures (e.g., ditches and berms, conveyance channels, rock/rip rap, outlet protection, sediment traps or basins, straw bale barriers, silt fence, check dams). Additionally, the SWPPP includes monitoring and maintenance of all control devices and structures

during active construction on 1 of 2 schedule; at least once every 14 days, and within 24 hours of a precipitation event greater than 0.5 inches. After active construction is finished but before complete reclamation has occurred, these structures and devices would be inspected a minimum of once per month with the exception of during extended periods of frozen ground conditions over the entire site. If unacceptable erosion impacts are discovered during inspections, additional BMPs would be employed to mitigate the impacts.

Table 4.11-2 Slopes Over 25 Percent

Disturbance Area	Acres
Gas Hills Permit Area	1,047
GHPA Mine Unit 1	0
GHPA Mine Unit 2	54
GHPA Mine Unit 3	29
GHPA Mine Unit 4	15
GHPA Mine Unit 5	2

Where topsoil was not salvaged, overland travel on moist or wet soils could result in rutting and the mixing of topsoil with subsoil. Soil productivity would decrease, as a result of profile mixing and compaction, along with the loss in vegetative cover. Lander mitigation guidelines restrict construction with frozen material or during periods when the soil material is saturated or when watershed damage is likely to occur. This restriction would reduce the potential for rutting and soil mixing.

During periods of high moisture, shale-derived soils on steep slopes can become unstable resulting in soil creep or large landslides. Where Project components would be located on soils prone to slumping (**Figure 3.3-3**), an increase in the probability for soil mixing, erosion, and sedimentation would occur. In addition, Project components could be damaged, causing a release of lixiviant or other ISR solutions. This could result in large scale contamination to soils. See Section 4.3.2.1 Geologic Hazards, for further discussion on impacts associated with landslide prone areas in the GHPA.

As discussed in more detail in Section 2.3.1.3, Access Roads, construction of new access roads would begin with vegetation removal. For bladed roads, topsoil would be removed and salvaged from the road construction area. As needed, access roads would be graded to allow for safe access and construction. Roads result in removal of vegetation, thereby interrupting nutrient cycling and altering soil productivity. Indirect effects could include generation of side cast materials and an increase in erosion leading to increased sedimentation at drainage crossings. Where the topography is relatively flat and grading occurs, disturbance would be limited to the upper subsoil horizons. As a result, deeper subsoils would not be subject to profile mixing. Where roads occur on steeply sloping areas, cut and fill slopes could be required. Cut and fill slopes result in subsurface soil mixing and a much greater percentage of loose soils prone to erosion. In addition, where construction modifies the slope face (cut and fill) the incidence for slope failure increases.

Two methods of construction are proposed to install pipelines, by spider plow or trenching. Spider plows typically are limited to installation of small diameter flexible pipe. Small diameter pipelines installed by spider plow would create minimal disturbance because trenching would not be required. The pipeline essentially would be plowed into the soil with minimal surface disturbance or soil profile modification. Trenching would be required for installation of large pipelines, but also could be used for small diameter pipes in some instances. Soil mixing and an alteration of soil profiles could occur during the trenching process. As described in Section 2.3.1.4, Pipelines, Cameco has committed to segregating topsoil from subsoil in areas where trenching occurs. Subsoil and topsoil would be replaced in sequence and seeded

at the first seeding window. This would help to maintain soil productivity and reduce the potential for soil mixing.

Biological soil crusts are highly susceptible to disturbance, especially in sandy soils (Belnap and Gardner 1993). Recovery rates generally are slow for lichen and moss recovery, which can take 45 to 250 years, respectively (Belnap and Gillette 1997). Losses of biological soil crusts would be expected where surface disturbance occurs. Surface roughness or crusts (biological or physical) would be damaged by construction activities (i.e., clearing, grading, excavation, vehicle traffic) and likely would be susceptible to wind or water erosion even in locations not rated as erosion prone.

LRP soils have chemical characteristics such as high salts, sodium, or pH that may limit plant growth. Saline soils affect plant uptake of water and sodic soils often have drainage limitations. In addition, the success of stabilization and restoration efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical and chemical characteristics of the soils. Losses in soil productivity, due to wind erosion of topsoil, would be most likely to occur on LRP soils with characteristics of saline, sodic, alkaline, or soils that were formed in locations with some lake sediments.

Adverse impacts would include the loss of soil quality and long-term productivity where facilities and roads would be located during the life of the Project. A decrease in soil productivity and quality also would occur in association with planned soil salvage and stockpiling activities as microbial action would be curtailed, at least to some degree, in the constructed long-term stockpiles. Interim reclamation of disturbed areas not needed for operations would help to reduce erosion from mine units. Once successful final reclamation has been achieved these impacts would be reduced to below significant.

Mitigation

The following mitigation measures are proposed to further avoid, minimize, or mitigate Project-related impacts to soils from construction. If adopted, the implementation of the additional mitigation measures would reduce the potential for soil impacts to less than significant.

SOL-1: As indicated in mitigation measure GEO-1, surface disturbance on slopes over 25 percent would require a site-specific engineering plan. Additionally, a site-specific reclamation plan would be developed and submitted for approval by the AO prior to initiation of surface disturbing activities. The plan would address each of the reclamation requirements detailed in BLM IM No. WY-2009-022 (**Appendix F**).

Mitigation measure SOL-1 would facilitate reclamation efforts by preventing valuable topsoil loss and maintaining soil quality, productivity, and biological characteristics. This measure also would reduce erosion thereby reducing sedimentation to nearby waterbodies.

4.11.2.2 Operation

Disturbance associated with operation would include soil compaction and erosion by continued vehicle and foot traffic. These impacts would continue for the life of the project. Maintenance activities would result in localized soil disturbances typically of short duration if re-disturbance is necessary (such as for pipeline or power line repairs). As stated in Section 4.11.2.1, Construction, as part of the SWPPP, Cameco has committed to minimize erosion impacts through the use of erosion control and channel stabilizing measures.

Soil contamination could result if spills of the lixivant or pregnant solution occurred. A SPCCP would be developed according to federal and state requirements and regulations, as described in Section 3.8, Public Health and Safety. **Table 4.11-3** provides a summary of soil characteristics that would be impacted during operations.

Table 4.11-3 Soils Disturbed During Operations for the Proposed Action (acres)

Type of Disturbance	Water Erodible	Compaction Prone[a]	LRP[b]	Shallow Bedrock[c]	Stony Rocky
Process Water Pipeline	0	0	0	0	0
Roads Operation ROW	13	6	10	0	5
Mine Unit 1[d]	30	19	23	0	10
Mine Unit 2[d]	101	7	87	0	19
Mine Unit 3[d]	27	3	26	0	1
Mine Unit 4[d]	85	10	12	5	67
Mine Unit 5[d]	13	2	2	0	3
Ponds, Drainage Diversion, Runoff Control Berm	11	8	8	0	5
Satellite Building West	3	2	2	0	1
Satellite Building Central	3	2	2	0	1
Topsoil Piles	1	1	1	0	0
Mine Unit 1 Monitoring Well Ring	3	1	2	0	1
Mine Unit 2 Monitoring Well Ring	2	1	2	0	1
Mine Unit 3 Monitoring Well Ring	4	1	4	0	0
Mine Unit 4 Monitoring Well Ring	3	1	1	0	2
Mine Unit 5 Monitoring Well Ring	1	0	0	0	0
Total	**300**	**64**	**182**	**5**	**116**

[a] These soils have 28 percent or more clay within the top 20 inches of soil.

[b] Limited reclamation potential.

[c] Lithic bedrock 60 inches or less from the soil surface.

[d] Disturbance within Mine Units and monitoring well rings is based on operational disturbances described in **Table 2-1** and the following assumptions: disturbance would be distributed equally across Mine Units, and all soils would have equal probability of being impacted.

Source: USDA-NRCS 2011.

Interim surface reclamation would occur after mine unit construction to stabilize the disturbed areas no longer needed during operations. Disturbed surfaces such as road ditches and the soils around header houses or power lines not used during mine unit operations would be stabilized.

Areas that have been compacted would be scarified, ripped, and/or disked as necessary to relieve the compaction and prepare for topsoil placement. Where needed, the surface would be graded and contoured to approximate original contours and to blend with the surrounding topography. Topsoil would be placed in a single lift to avoid compaction. On steep slopes topsoil would be placed along the contour. The soils would then be seeded with a BLM-approved seed mix. Noxious weeds would be controlled, as needed by annual spraying by a certified applicator using a registered herbicide following the timing recommendations.

Mitigation

The following mitigation measures are proposed to further avoid, minimize, or mitigate Project-related impacts to soils. If adopted, the implementation of the additional mitigation measures would reduce the potential for soil impacts to less than significant.

SOL-2: Two-track roads used for Project activities would be monitored quarterly for erosion, braiding, or severe rutting. If any of these were noted the appropriate steps would be taken to prevent further degradation (e.g., water bars, gravel, prohibition of traffic on native surface roads during wet periods).

SOL-3: During interim and final reclamation, compacted areas (typically any area that received repeated traffic or 3 or more passes by heavy equipment) would be decompacted, to the depth of compaction, by subsoiling (method for deep decompaction of soils, using a subsoiler, that does not result in soil mixing) or ripping to the depth of compaction. This would help prepare the seed bed, encourage infiltration and help to prevent accelerated runoff and erosion. Scarification would only be used on shallow soils. This mitigation measure also would apply to decommissioning activities.

Mitigation measure SOL-2 would reduce the potential for surface disturbance to soils and vegetation outside of a road footprint. This would reduce the potential for erosion and sedimentation to nearby drainages and prevent additional surface disturbance. Measure SOL-3 includes ripping, paraplowing, or subsoiling, which typically is the recommended mitigation for deeply compacted soils. Disking does not mitigate compaction, but can be used as a follow-up treatment to subsoiling or ripping to break up large soil clods and help to prepare the seed bed. Scarification only breaks up the surface layer and should only be used on shallow soils. These measures would ensure proper decompaction of compaction soils, to the depth of compaction. In addition, the proposed mitigation would increase the potential for successful reclamation on shallow soils by encouraging infiltration and helping to prevent accelerated runoff and erosion.

4.11.2.3 Decommissioning

During decommissioning and reclamation, the entire surface of each mine unit would be re-disturbed. Wells would be plugged and all subsurface infrastructure and surface facilities would be removed. Because mine units would be completely disabled, the same types and intensities of impacts to those described for construction in Section 4.11.2.1, Construction, would be expected. These impacts would be reduced once successful reclamation was achieved.

Prior to reclamation, all roads would be surveyed for radiological contamination in excess of radiological levels documented as pre-existing baseline conditions. Any contamination which resulted from the ISR operation would be cleaned up to appropriate U.S. NRC standards and the contaminated soils would be disposed of at an U.S. NRC-licensed facility. Following decontamination, the roads would be ripped and/or disked to relieve compaction. Excess imported gravel would be removed and disposed of appropriately. Culverts would be removed and pre-Project drainages reestablished. All reclaimed roads and ditches would be graded and contoured to blend with the surrounding terrain. Topsoil would be replaced and seeded.

State and federal regulatory programs that address mining project reclamation are administered by the WDEQ and BLM (BLM 2009a, 1987; WDEQ-LQD 1997). These regulations help reduce or mitigate impacts to the environment from mining. Under the applicable regulations, mining companies must develop detailed reclamation plans and establish financial assurances for their successful implementation. Such plans address concurrent reclamation and stabilization practices that are implemented as a project proceeds, as well as post mining practices that are implemented during the final stages of project completion. Concurrent reclamation typically consists of revegetation, erosion control, and associated drainage practices that minimize the impacts of clearing and accelerated erosion

during project activities. Final reclamation typically is conducted following completion of mining and processing activities. Development and implementation of a reclamation monitoring and reporting strategy also is required to ensure reclamation success. These standards and procedures would be applied to the Project to mitigate impacts associated with construction, operation, and decommissioning. Final reclamation would be determined by monitoring revegetation success. The success of revegetation in meeting the land use goals would be assessed prior to application for bond release by utilizing the COMA method as described in WDEQ-LQD Rules and Regulations Chapter 3, Section 2(d)(vi)(C) and LQD Guideline No.2-Vegetation.

Mitigation

The following mitigation measures are proposed to further avoid, minimize, or mitigate Project-related impacts to soils during decommissioning. If adopted, the implementation of the additional mitigation measures would reduce the potential for soil impacts to less than significant.

SOL-4: A monitoring plan would be developed and submitted to the BLM for approval. The plan would address the following:

- Soil erosion/movement;
- Vegetation: density, diversity (species composition) and age class (e.g., seeding, mature plant, decadent plant);
- Weeds: density, species composition;
- Photo reference points;
- Compliance with reclamation plan;
- Documenting/monitoring protocols;
- Timing of monitoring during the year; and
- Identification of sites needing additional work or more reclamation activities outlining a site-specific prescription for actions to be implemented, including:
  - Re-seeding of areas not attaining reclamation success,
  - Soil stabilization,
  - Weed control, and
  - Mulching/fertilization or other cultural practices.

Mitigation measure SOL-4 would prevent further degradation or loss of soil resources after reclamation has been completed, would reduce the potential for loss of topsoil, and would reduce the potential for occurrence of large rills and gullies. Mitigation SOL-3 also would apply during decommissioning.

Residual Impacts

The identified mitigation measures, if properly applied, would reduce impacts to soil resources; therefore, residual impacts would be minimal.

4.11.3 Resource Protection Alternative

This alternative would have similar impacts to the Proposed Action, except the overall surface disturbance within the mine units during construction and operation would be less than the Proposed Action. Under the RPA there would be 783 acres of soil disturbance compared to 1,315 acres of soil disturbance under the Proposed Action Alternative. Surface disturbance would be reduced through the use of the closed loop drilling system that eliminates the excavation of drilling mud pits, the reduced

number of evaporation ponds, and annual development planning that would identify procedures to constrain surface disturbance to the planned areas.

As stated in Section 2.4, Resource Protection Alternative, a TMP would be developed as part of the RPA. The TMP would address the need to maintain topsoil viability in the long-term (remaining longer than 1 year) topsoil stockpiles. The overall goal of the TMP would be to limit surface disturbance activities to less than the entire mine unit during construction activities and to eliminate random or unplanned cross-country travel during mine unit operation. This would reduce the potential for rutting and soil compaction across the mine units. This also would help to maintain soil productivity of disturbed soils.

Under the RPA, a reclamation coordinator would be on-site during any surface disturbance, particularly during more intense construction activities such as well drilling and installation of underground utilities. The reclamation coordinator would have sufficient training in soils to provide expert input on the depth of soil to be removed when stripping topsoil and would be responsible for implementing the TMP and adjusting the plan to changing field conditions throughout the life of the Project. An objective of the TMP is to maintain topsoil viability through, as proper segregation of topsoil is critical to successful reclamation. The reclamation coordinator would be responsible for documenting, by using photographs or other means approved by the BLM, that no travel of mechanized equipment occurred outside of flagged areas. This would help reduce the potential for mixing chemically or physically unsuitable subsoils with topsoil.

Annual development planning would help to limit soil disturbance across the entire mine unit. This would reduce compaction and large scale impacts to soil quality. The RPA would include enhanced reclamation goals and timing. Prompt reclamation of disturbed areas would reduce the potential for soil loss through revegetation and soil stabilization. This alternative would not allow construction of Mine Unit 3 until interim reclamation on Mine Unit 1 was shown to make significant progress toward meeting reclamation success criteria. Likewise, construction of Mine Unit 4 would not begin until Mine Unit 2 interim reclamation was successful, and Mine Unit 5 construction would not begin until Mine Unit 3 interim reclamation was demonstrated to be successful. This would help to reduce the overall impacts that occur to soils at 1 time. This also would help to reduce the soil erosion and sedimentation occurring within each watershed at any given time.

Final reclamation goals under this alternative would be evaluated using the USDA reclamation criteria established in the Draft Lander RMP (BLM 2011b). These criteria are based on the NRCS ESD for each mapped ecological site found in the GHPA (USDA-NRCS 2011). These goals potentially could enhance the soil quality and revegetation to closely match the native plant communities relative to an undisturbed state. The RPA potentially would reclaim the areas to a better condition than the currently existing condition. In comparison, the Proposed Action would reclaim the sites to resemble current conditions. The criteria for reclamation success are outlined in Section 2.4.7.1, Reclamation Success Criteria.

Mitigation

Mitigation measures described for the Proposed Action also would be applicable to this alternative.

Residual Impacts

The identified mitigation measures would help to reduce impacts to soil resources to less than significant; therefore, residual impacts would not be anticipated.

4.11.4 Irreversible and Irretrievable Impacts

An irretrievable commitment of a resource is 1 in which the resource or its use is lost for a period of time. An irretrievable loss of soil productivity and quality would be lost for the life of the Project on approximately 633 acres (Proposed Action) or 317 acres (RPA) associated with production and

monitoring wells, header houses, ponds, pump stations, and Project roads. No irreversible impacts would be anticipated.

4.11.5 Relationship between Local Short-term Uses and Long-term Productivity

Implementation of the Project would result in accelerated erosion and soil loss during construction and loss of productivity of vegetative cover and forage at production and monitoring wells, header houses, pump stations, ponds, and access roads for the life of the Project. However, implementation of reclamation measures would restore the long-term productivity of affected soils after the Project was reclaimed, assuming regular monitoring for effectiveness demonstrates successful reclamation.

4.12 Transportation

Primary access roads in the GHPA are mostly county- and BLM-maintained roads. State routes, U.S. Highways, and an Interstate Highway also would be utilized by Project-related activities. The greatest impact to transportation resources would be through increased traffic trips generated during construction and operation.

Transportation issues associated with the Project were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process, and include:

- Increased traffic on Wyoming State Route 136 and Gas Hills Road (CR 212), as well as on other Project area regional roads in the area around the Project; and
- Increased risk of accidents on GHPA and regional roads due to increased traffic and truck transportation.

Analysis of impacts to transportation was completed by comparing assumed existing traffic patterns to projected increases in Project-related traffic. Existing traffic data on county and rural roads within and near the GHPA was not available. Existing traffic is assumed to be light on the rural road network within and near the GHPA due to the remote nature of the area. Impacts from transportation specific to air quality, wild horses, and wildlife can be found in Section 4.1, Air Quality; Section 4.16; Wild Horses; and Section 4.17, Wildlife and Fisheries.

Assumptions used to analyze impacts to transportation include:

- Construction and processing materials primarily would be transported to the GHPA via Wyoming State Route 136 and Gas Hills Road (CR 212);
- Over the road vehicles would comply with WYDOT rules and regulations; for example, all contractors hauling loads that exceed WYDOT's oversize and/or overweight standards would acquire the requisite permits and comply with WYDOT safety regulations;
- Cameco does not anticipate overweight loads would be transported to the GHPA;
- All use and modification of Fremont and Natrona county roads would be conducted in accordance with county regulations; and
- All roads within the GHPA would be constructed to design specifications contained in the BLM Gold Book (BLM 2007) and BLM Manual 9113 (1985).

4.12.1 No Action Alternative

Under the No Action Alternative, in-situ mining activities would not take place within the GHPA, and there would be no change to currently authorized transportation activities. Approximately 3 miles of roads within the GHPA would be reclaimed. Reclamation of these roads would reduce access within the GHPA.

4.12.2 Proposed Action Alternative

Under the Proposed Action, up to 6 miles of new primary road, designed for transportation of employees and materials to and from the Project, would be constructed within the GHPA. This new road would supplement the 8 miles of existing primary roads within the GHPA. In addition, approximately 16 miles of secondary roads would be constructed to supplement, and in some cases, replace, approximately 28 miles of existing secondary roads within the GHPA. Approximately 2 miles of existing secondary roads would be within proposed mine unit boundaries, and would be removed during mine unit

construction. Impacts associated with construction of new roads would be resource-specific, and are discussed throughout this document.

Transportation resources would be impacted through additional vehicle trips. These impacts would be greatest during the construction phase of the Project and could consist of increased road maintenance, elevated traffic levels outstripping the existing capacity of roads, and a heightened potential for accidents. The projected maximum daily trips per day for the Proposed Action Alternative during mine unit construction would be 22 heavy truck trips and 7.4 light truck trips a day (Cameco Transportation Plan, **Appendix G**). Drilling would occur 16 days a month; however, this analysis averaged vehicle trips and miles over 365 days to develop comparable numbers. The number of vehicles would be higher during drilling days. During 2013, construction of mining infrastructure, process buildings, and evaporation ponds would begin and would last 1 year. Construction of additional infrastructure also would take place in 2018, lasting 1 year. During both these years an additional 0.8 heavy truck trips and 3.3 light truck trips would occur each day. Construction in 2013 and 2018 would occur 300 days a year; however, the analysis averaged vehicle trips and miles over 365 days to develop comparable numbers.

Cameco estimates that during operation, an average of 1.2 heavy truck trips a day and 46 light truck trips a day would occur (**Appendix G**), for Project operations. Heavy truck trips would include required deliveries to support resin operation, commercial delivery service, waste transportation, and resin transportation. Of the anticipated 1.2 heavy truck trips a day, approximately 0.9 trips daily, or 325 annually, would result from resin transport to the Smith Ranch-Highland facility. An additional estimated 3.0 heavy truck trips per day (1,085 annually) would transport chemicals used for uranium recovery to and from the GHPA (**Table 4.8-1** and **4.8-2**). Light truck trips would consist of transporting operations personnel. Of the daily personnel transportation trips, 80 percent would be anticipated to come from Riverton and 20 percent from Casper. Project personnel would utilize Wyoming State Route 136 from Riverton or Gas Hills Road from Waltman.

Transporting resin to the Smith Ranch-Highland facility would take place on 37 miles of unpaved roads and 105 miles of paved roads (**Figure 2.3-2**) would utilize the roads detailed in Cameco's Transportation Plan (**Appendix G**). Capacity for 7 days of resin would be housed at the Carol Shop facility for storage in the event roads become impassible due to inclement weather. Snow removal on state routes, U.S. highways, and interstates currently is, and would continue to be, provided by the State of Wyoming. Furthermore, Cameco also would utilize its own snow removal equipment as detailed in the Transportation Plan (**Appendix G**). Road maintenance crews would be contracted to assist in the event of a road closure lasting more than 7 days.

The greatest impact to transportation would be increased traffic in and near the GHPA and the use of new and existing roads during construction. Existing traffic data was not available for the Gas Hills Road connecting to U.S. 20/26, but based on the assumption that 80 percent of construction traffic would come from Riverton (Transportation Plan, **Appendix G**) and utilize Wyoming State Route 136, traffic would increase approximately 11 percent on Wyoming State Route 136 from existing levels. Traffic data for Wyoming State Route 136 was collected by the WYDOT. As detailed in Section 3.12, Transportation, 2010 current traffic levels on Wyoming State Route 136 are very light, approximately 208 vehicles daily. An increase in traffic of 11 percent would not be anticipated to exceed the capacity of Wyoming State Route 136. With the exception of resin or chemical transportation, it is anticipated that the majority of operations traffic would come from Riverton (**Appendix G**), and would cause an increase of 23 percent in vehicle traffic from existing levels on Wyoming State Route 136. This increase in traffic also would not be anticipated to exceed the capacity of Wyoming State Route 136. The addition of approximately 1 heavy truck trip daily to the Smith Ranch-Highland facility and 3 heavy truck trips daily to transport chemicals also would not exceed the capacity of the existing road network. Therefore, impacts of the Project to the existing capacity of transportation resources would be minimal.

New roads and existing roads within the GHPA would be maintained to a level able to accommodate anticipated project traffic. Increased traffic on existing roads may incrementally increase maintenance

costs. Cameco's Transportation Plan (**Appendix G**) details emergency transportation plans and includes a more in-depth description of construction and operation traffic. Potential accident rates for all sections of roadway utilized by the Project, where data are available, are presented in Section 4.8, Public Health and Safety.

Mitigation

Because anticipated impacts would not be significant, no additional mitigation measures to avoid, minimize, or mitigate impacts would be required.

Residual Impacts

No significant impacts would be anticipated due to transportation associated with the Project, and therefore, residual impacts also would not be anticipated.

4.12.3 Resource Protection Alternative

The RPA would be similar to the Proposed Action, except that uranium bonded to resin would be processed to slurry at the Gas Hills facility before being transported to the Smith Ranch-Highland facility. Under this alternative, heavy truck trips for Project operation would decline from an average of 1.2 daily trips to 0.7 daily trips. Light truck trips would remain the same as the Proposed Action. Heavy truck trips would be reduced to 122 annual trips to the Smith Ranch-Highland facility as opposed to 325 annual trips under the Proposed Action. Forty-eight more annual trips than the Proposed Action would occur as a result of chemical deliveries to support the additional processing; however, there would be 155 fewer trips, under the RPA than the Proposed Action. Fewer vehicle trips would produce less traffic in and near the GHPA, resulting in less impact than the Proposed Action.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No residual impacts would be anticipated.

4.12.4 Irreversible and Irretrievable Commitment of Resources

Project-related traffic increases and subsequent impacts to transportation would be irretrievable for the life of the Project. However, these impacts would not be irreversible as they would cease at Project closure. Project-related impacts due to the development of new roads within the GHPA would be reversible, with reclamation of roads constructed for the Project. No irretrievable impacts would be anticipated from either of the action alternatives.

4.12.5 Relationship between Local Short-Term Uses and Long-Term Productivity

Over the 25-year life of the Project, a maintained road network would be in place for enhanced recreational access and other uses within the GHPA. Over the long-term, access roads would be reclaimed, resulting in a reduction of the transportation network in the GHPA and reduced access to the area.

4.13 Vegetation

This section describes potential impacts to vegetation resources that could occur from activities associated with the Project and alternatives. The GHPA was the area evaluated for impacts for vegetation resources.

The primary issues associated with vegetation resources were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process, and include direct and/or indirect impacts to special status plant species; riparian/wetland habitats; forage production rates in rangeland areas; and impacts associated with the introduction and/or spread of noxious weeds and invasive species. See specific resource sub-sections for further discussion on special status species, and noxious weeds and invasive species. See Section 4.5, Livestock Grazing, for further discussion on impacts to range resources.

Impacts to vegetation and wetland resources were identified based on the locations of these resources in relation to the proposed surface disturbance areas.

The following assumptions were used in the analysis of impacts to vegetation resources:

- Areas of recently disturbed bare ground would be more susceptible to erosion and invasion by non-native species.
- Erosion from disturbed areas would be minimal once vegetation or other surface stabilization was established. Successful establishment of herbaceous vegetation generally takes a minimum of 3 to 5 years, depending on soil and precipitation, and requires monitoring until the BLM determines the reclamation to be successful.
- Reclamation on areas with soil reclamation constraints (as defined in Section 4.11, Soils), especially with saline and/or alkaline soils would be difficult, and successful reclamation could require additional mitigation measures.
- Extensive networks of pipelines, access roads, drilling infrastructure, and other utility corridors could lead to fragmentation of native landscapes, which can decrease species diversity, lead to decrease in the number and populations of native and special status species, and provide corridors for invasion of non-native species.
- Surface disturbance activities would result in the conversion of woody vegetation cover types to grass/forb-dominated vegetation in the short term.
- Applicant-committed environmental protection measures listed in Section 2.3.8, Existing Monitoring Plans, the Revised PoO (PRI 2011a) and the WDEQ Mine Permit Application (PRI 2009) were taken into account in determining impacts.

4.13.1 No Action Alternative

Under the No Action Alternative, the Project would not be approved. Current land use and surface-disturbing activities would continue as currently authorized. Under this alternative the Carol Shop, portions of the AML road, and previously disturbed lands would be reclaimed, resulting in the reclamation of approximately 40 acres. Exploratory drilling would continue at the rate of approximately 5 acres a year. Reclamation of these sites would be anticipated to occur within the same calendar year as the disturbance. Mining-related exploration activities on BLM-managed lands may not result in over 5 acres of unreclaimed surface disturbance at any time during the life of the NOI filed for each action.

4.13.2 Proposed Action Alternative

Under the Proposed Action Alternative, surface infrastructure (processing facilities, waste water disposal facilities, roads, header houses, and power lines) and subsurface infrastructure (wells, pipelines,

electrical lines, and communication cables) would be constructed in the GHPA. Mine unit development would occur in phases with each mine unit taking several years to be developed. Each mine unit would be projected to operate over a period of 13 to 17 years, with interim reclamation taking place concurrently with development activities, and final reclamation and decommissioning occurring at the end of the Project. Cameco would implement construction and operations using environmental protection measures as described in Section 2.3.9, Applicant-Committed Environmental Protection Measures, the Revised PoO (PRI 2011a), the SWPPP and the WDEQ Mine Permit Application Reclamation Plan (PRI 2009). Construction and operations also would be consistent with the BLM recommended BMPs, and the Lander and Casper RMP objectives and stipulations.

4.13.2.1 Vegetation

Under the Proposed Action Alternative, the Project would directly remove or impact a total of 1,315 acres of vegetation. **Table 4.13-1** identifies acreage of Project-related disturbance by vegetation community type for construction and operation activities associated with mine components and related infrastructure. The entire surface within each mine unit would be disturbed from construction activities. The majority of the Project-related disturbance would occur in the mixed sagebrush-grassland and the rough breaks (East) vegetation community type. In addition, vegetation along existing access roads would be affected by increased dust deposition (e.g., reductions in growth rates). Impacts are described below as either short-term or long-term. Short-term impacts are defined as occurring within 3 to 5 years following surface disturbance, while long-term impacts are defined as those lasting longer than 5 years.

Short-term direct impacts from Project-related activities would include the trampling of herbaceous vegetation, clearing/blading of surface cover, and removal of vegetation during construction. Long-term direct and indirect impacts would include the long-term loss of vegetation for facilities during the life of the Project and the permanent conversion of native vegetation communities resulting from the spread of noxious and invasive species, fragmentation of native vegetative communities, and conversion of shrub-dominated vegetation cover type to a grass/forb-dominated vegetation cover type. See Section 4.13.2.2, Noxious Weeds and Invasive Species, for discussion of the impacts related to noxious and invasive weed species. Fugitive dust accumulation on plants has been shown to adversely affect a variety of plant functions and high dust accumulations can lead to partial defoliation, increased plant mortality, and decreases in growth rates and vigor (BLM 2007a; USEPA 2008b; USFWS 2008). Fragmentation of vegetative communities would result from the development of a network of access roads, utilities, and well pads, which can impact native vegetative communities and native plant species. Impacts from fragmentation could include the loss of suitable habitat, more exposure to disturbances, and increased competition (BLM 2007a). Vegetative communities also could be affected by damage to biological soil crusts, as described in Section 4.11, Soils.

Project-related activities in sagebrush shrubland areas (including bottomland sagebrush and mixed sagebrush grassland) would result in the conversion of a shrub-dominated vegetation cover type to a grass/forb-dominated vegetation cover type in the short term. Over the long term, shrubs would become re-established and increase in abundance within the majority of disturbed areas as a result of reclamation and natural re-colonization. The loss of 743 acres of shrub-dominated vegetation would represent a long-term impact as it would take up to 20 years following reclamation for mature shrub species to re-establish (USDA 2004, BLM 2007a).

In Mine Unit 4, approximately 15 acres of wetlands along WWC would be potentially disturbed by construction activities related to development of the Mine Unit, and the access road and pipeline construction ROWs. As described in the PoO (PRI 2011a) and the Mine Permit Application Operations Plan (PRI 2009), wetlands within the limits of the GHPA generally would be avoided. Following completion of delineation drilling, injection and recovery wells would be located outside

Table 4.13-1 Acreages of Affected Vegetation Communities under the Proposed Action Alternative

Mine Component			Vegetation Communities							
			Bottomland Sagebrush (acres)	Disturbed Land (acres)	Mixed Sagebrush-grassland (acres)	Reclaimed Areas (acres)	Rough Breaks East (acres)	Rough Breaks West (acres)	Upland Grassland (acres)	Wetlands (acres)
Mine Units, Including Monitoring Well Rings	Mine Unit 1	Construction	18	-	98	-	<1	25	25	<1
		Operation	9	-	49	-	<1	12	13	<1
	Mine Unit 2	Construction	6	-	168	43	142	-	16	-
		Operation	3	-	85	21	72	-	8	-
	Mine Unit 3	Construction	-	48	31	5	-	15	-	-
		Operation	-	24	16	3	-	8	-	-
	Mine Unit 4	Construction	18	<1	177	4	50	-	-	15
		Operation	9	<1	89	2	25	-	-	7
	Mine Unit 5	Construction	13	2	46	50	7	-	-	-
		Operation	6	1	23	25	3	-	-	-
Project Infrastructure	Roads with Utility Corridors	Construction	28	25	111	15	4	19	6	<1
		Operation	5	4	20	3	<1	3	1	<1
	Disposal Wells	Construction	--	--	2	2	--	2	--	--
		Operation	--	--	1	1	--	1	--	--
	Satellite Building Central	Construction	1	-	4	-	-	-	-	-
		Operation	1	-	4	-	-	-	-	-
	Satellite Building West	Construction	-	-	5	-	-	-	-	-
		Operation	-	-	5	-	-	-	-	-
	Water Management	Construction	8	27	8	20	-	-	-	-
		Operation	8	27	8	20	-	-	-	-
	Topsoil Piles	Construction	<1	<1	2	<1	<1	<1	<1	-
		Operation	<1	<1	2	<1	<1	<1	<1	-
Total		Construction	93	102	651	136	204	60	47	15
		Operation	42	57	301	73	101	25	22	8

the boundary of the wetlands; however, access roads and pipe lines may require crossing of wetland areas (Appendix D-11, PRI 2009). Potential short-term and long-term impacts to wetlands would be dependent on the placement of delineation wells, access roads, and overhead power lines within the mine unit. Short-term impacts could include, but would not be limited to; clearing of all hydrophytic vegetation, temporary erosion and sedimentation of stream channels, and the introduction of contaminants into flows and/or existing channel sediments. Long-term impacts could include loss of wetlands resulting from overhead power lines and access road placement during the life of the Project, and long-term changes in surface and groundwater flows.

As described in the PoO and the Mine Permit Application Operations Plan (PRI 2011a, 2009), jurisdiction of wetlands impacted by development on Mine Unit 4 would be determined in consultation with the USACE. If required, the applicant would develop a mitigation plan for impacts to jurisdictional wetlands that would be approved by the WDEQ-LQD, BLM, and USACE. Prior to mine unit development, the final locations of wells would be identified and submitted for approval by the WYDEQ-LQD. At that time specific impacts to wetlands would be determined, and any required state and federal permits and mitigation plans developed and submitted for approval. As actual surface disturbance locations and their relation to wetlands in the mine units is unknown, it is assumed for the impact analysis that the Project has the potential to impact wetlands in Mine Unit 4.

Where access roads and pipelines cross perennial and intermittent drainages, BMPs as detailed in the Mine Permit Application Operation Plan (PRI 2009) would be implemented to prevent erosion and sedimentation of those drainages. BMPs implemented could include the construction of ditches and berms, riprap, sediment basins, and silt fences to prevent sedimentation and erosion. Any spills or discharge of pollutants into Waters of the State via storm water runoff would be managed using the BMPs described in the SWPPP. See Section 2.3.8, Existing Monitoring Plans, for the BMPs listed in the SWPP. To minimize fugitive dust and collisions with wildlife and livestock, access roads in the wellfield areas would have reduced speed limits, and would consist of either unconstructed light use 2-track roads or constructed narrow access roads. In addition, disturbed areas would be reclaimed as described below.

The total amount of surface disturbance at a given time would be minimized through the phased development of each mine unit. After completion of mine unit construction, and after operations start, approximately 95 percent of the mine unit would undergo interim reclamation to stabilize the disturbed soils. However, an estimated 45 percent of the mine unit would be impacted by cross-country mechanized travel to well heads, for a total of 50 percent disturbance of a mine unit during operation. Interim reclamation would occur concurrently with operations. Interim reclamation is described in Section 2.3.2.5, Interim Reclamation, and would focus on disturbed surfaces not used during mine unit operation. Disturbed surfaces would be scarified and contoured, if necessary, followed by topsoil placement and seeding with a BLM-approved seed mix (**Table 4.13-2**). Topsoil stockpiles that would be stored for more than a year would be seeded with just the grasses from the approved reclamation seed mix. Where conditions prevent seeding for a period of time longer than 3 months, disturbed areas would be temporarily treated until interim reclamation could occur. Temporary treatments could include scarification, mulching with straw mulch, or seeding with a temporary cover crop (e.g., barley, winter wheat, millet, or rye) at 30 pounds/acre. In addition, disturbed areas with slopes greater than 25 percent would immediately be mulched with straw mulch or seeded with a temporary cover crop. Erosion controls would be installed as appropriate to prevent erosion and sedimentation.

Final reclamation would occur after mining was complete and groundwater restoration had been deemed successful in a mine unit (Section 2.3.5, Mine Unit Restoration and Reclamation). A detailed description of final reclamation activities is included in the Mine Permit Application (PRI 2009). During final reclamation, facilities would be removed, wells would be plugged and abandoned, and access roads would be reclaimed. All disturbed surfaces would be scarified, ripped, and/or disked as appropriate, and graded and contoured to approximate original contours to blend with the surrounding topography. Salvaged

Table 4.13-2 Interim and Final Reclamation Seed Mix for the Proposed Action[a]

Common Name	Scientific Name	Variety	lbs PLS[b]/ac
Westem Wheatgrass[c]	*Agropyron smithii*	Rosana	3.00
Thickspike Wheatgrass[c]	*Agropyron dasystacum*	Critana	3.00
Slender Wheatgrass[c]	*Agropyron trachycaulum*	Pryor	3.00
Ricegrass	*Oryzopsis hymenoides*	Nespar	2.00
Green Needlegrass	*Stipa viridula*	Lodorm	2.00
Sheep Fescue[d]	*Festuca ovina*		2.00
Gardner Saltbush	*Atriplex gardneri*		0.75
Cicer Milkvetch	*Astragalus cicer*	Lutana	0.50
Shadscale Saltbush	*Atriplex confertifolia*		0.50
Big Sage	*Artemisia tridentate*		0.50
Antelope Bitterbrush[e]	*Purshia tridentate*		0.50
Total lbs. PLS/Acres			17.75

[a] If any of the above seed or approved substitutes become unavailable or cost prohibitive, reasonable substitutions could be made with prior approval of WDEQ-LQD and BLM. If more locally adapted varieties of certified seed become available, they could be substituted with prior approval of WDEQ-LQD and BLM. For temporary seeding of topsoil stockpiles, only the grasses listed in the seed mix would be used.

[b] The stated seeding rates are for Pure Live Seed (PLS). Percent PLS is the total of multiplying germination plus dormant or hard seeds by the percent purity.

[c] Streambank Wheatgrass (*Elymus lanceolatus*) or Bluebunch Wheatgrass (*Agropyron spicatum*) could be added to or substituted for any of the listed wheatgrass species as long as the total wheatgrass mix does not exceed 10 lbs. PLS per acre.

[d] Idaho Fescue (*Festuca idahoensis*) could be substituted for Sheep Fescue at 2 lbs. PLS per acre.

[e] Winterfat (*Krascheninnikovia lanata*) could be substituted for Antelope Bitterbrush at 0.5 lbs. PLS per acres.

topsoil would be re-applied. Seeding would be conducted using the pitting and seeding method; drill or broadcast seeding would be used during fall and spring seeding windows in limited areas. To cover newly seeded areas, these areas would be raked or dragged. Final reclaimed areas would be fenced for a period of at least 2 years or until the vegetation was capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization. The fencing would not be removed until the WDEQ-LQD and BLM agree that the revegetated areas were able to support livestock grazing.

Vegetation cover types could recover at varying rates. Herbaceous-dominated plant communities (including the reclaimed areas and upland grasslands) would typically take 3 to 5 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations. Woody-dominated plant communities (including bottomland sagebrush and mixed sagebrush grassland) would require up to 20 years for shrubs of similar stature to recolonize the area (BLM 2007a). Reclamation efforts could take longer in areas with soil reclamation restraints (see Section 4.11, Soils for further discussion).

As referenced in the Mine Permit Application, the goal of final reclamation would be to restore the land to a condition that would sustain the current land use of livestock grazing and wildlife habitat in accordance with WDEQ guidelines. These guidelines outline specific vegetation parameters that would be used to compare reclaimed areas against a COMA that were identified during baseline vegetation surveys. Two

COMAs that are representative of the various vegetation types in the GHPA were established during additional vegetation sampling conducted in 2007. The COMAs and vegetation surveys are described in further detail in Addendum D8 of the Mine Permit Application (PRI 2009). Successful revegetation at the end of the bonding period is defined as when:

1. The vegetation species of the reclaimed land are self-renewing under natural conditions prevailing at the site;
2. The total vegetation cover of perennial species (excluding noxious weed species) and any species in the approved seed mix is at least equal to the total vegetation cover of perennial species (excluding noxious weed species) on the area before mining;
3. The species composition and diversity are suitable for the approved post-mining land use; and
4. The above are achieved during a single growing season, no sooner than the fifth full growing season on the reclaimed lands.

Mitigation

The following mitigation measures are proposed to further avoid, minimize, or mitigate Project-related impacts to vegetation resources.

VEG-1: Project disturbances would avoid wetlands as identified in the Mine Permit Application and the vegetation surveys conducted by HWA (HWA 2011a). Surface disturbance would not occur within the wetlands along WWC. Erosion and sediment BMPs as described in the SWPPP (PRI 2009), would be implemented within 500 feet of wetlands located within the vicinity of surface disturbance associated with the Project.

VEG-2: In areas of LRP due to saline and/or alkaline soils, the saline and alkaline tolerant seed mix in **Table 4.13-3** would be used.

Implementation of mitigation measure VEG-1 would reduce impacts to wetlands by avoiding surface disturbances in mapped wetlands and implementing erosion and sedimentation controls within 500 feet of wetlands. The implementation of erosion and sedimentation controls within the 500 feet of wetlands would ensure that wetlands would not be impacted by overland surface flow, and sedimentation resulting from surface disturbance associated with the Project. Implementation of VEG-2 would assist in reclamation efforts in areas with LRP due to saline and/or alkaline soils within the GHPA.

Residual Impacts

Vegetation recovery to similar cover and species composition after implementation of a reclamation program would be expected to occur over the long term (longer than 5 years). Herbaceous-dominated plant communities would require an estimated minimum of 3 to 5 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations. Woody-dominated plant communities would require up to 20 years for shrubs of similar stature to recolonize the area. Fragmentation and the conversion of vegetation communities could occur over the long term, depending on the success of reclamation.

Residual impacts due to the loss of sagebrush habitat are discussed in Section 4.17, Wildlife and Fisheries. Implementation of mitigation measures would result in no residual impacts to wetland resources.

4.13.2.2 Noxious Weeds and Invasive Species

Under the Proposed Action Alternative, a total of approximately 1,315 acres of vegetation would be removed or disturbed (**Table 4.13-1**). Following surface disturbance activities, noxious weeds and invasive species could colonize areas that typically lack or have minimal vegetation cover. Surface

Table 4.13-3 Proposed Interim and Final Saline/Alkaline Reclamation Seed Mix, Mitigation Measure VEG-2[a]

Common Name	Scientific Name	Variety	Pounds Pure Live Seed/Acre
Westem Wheatgrass	*Agropyron smithii*	Rosana	3.00
Thickspike Wheatgrass	*Agropyron dasystacum*	Critana	3.00
Slender Wheatgrass	*Agropyron trachycaulum*	Pryor	3.00
Ricegrass	*Oryzopsis hymenoides*	Nespar	2.00
Idaho Fescue	*Festuca idahoensis*		2.00
Cicer Milkvetch	*Astragalus cicer*	Lutana	0.50
Yarrow	*Achillea spp.*		0.25
Gardner Saltbush	*Atriplex gardneri*		0.75
Shadscale Saltbush	*Atriplex confertifolia*		0.75
Bud Sage	*Artemisia spinescens*		0.50
Winterfat	*Krascheninnikovia lanata*		1.00
Total Pounds Pure Live Seed/Acre			**16.75**

[a] If any of the above seeds or approved substitutes become unavailable or cost prohibitive, reasonable substitutions could be made with prior approval of the WDEQ-LQD and BLM. If more locally adapted varieties of certified seed becomes available, they could be substituted with prior approval of the WDEQ-LQD and BLM.

[b] The stated seeding rates are for Pure Live Seed (PLS). Percent PLS is the total of multiplying germination plus dormant or hard seeds by the percent purity.

disturbance and increased vehicle travel along new routes could spread noxious weeds and invasive plant species and colonize areas with minimal vegetation cover or recently disturbed areas (BLM 2007a). Noxious weed species can degrade and modify native communities, reduce structural and species diversity, and out-compete native species (BLM 2007a). Cheatgrass, already present in the GHPA, is a concern as it can alter the local fire regime and fire-recurrence interval, often resulting in alteration of species composition of native communities.

Implementation of the applicant-committed environmental protection measures and the Reclamation Plan would reduce the potential for noxious weeds and invasive species spread and establishment in the GHPA. The Mine Permit Application Operations Plan (PRI 2009) states that during operations and following surface reclamation, noxious weeds would be controlled by annual spraying on an as-needed basis, until final bond release was obtained. Final bond release would be contingent on revegetation success as defined in Section 4.13.2.1, Vegetation. Noxious weed control would be performed only by individuals with appropriate state and BLM pesticide certifications. Even after successful reclamation, populations of weedy annual species (e.g., halogeton) could remain established in localized areas.

All surface disturbance would be reclaimed either concurrently during the shift from construction to operations or once mining was complete. Noxious weed management would continue during the post-mining reclamation period and the post-closure monitoring period.

Mitigation

The following mitigation measures are proposed to further avoid, minimize, or mitigate Project-related impacts related to noxious weeds and invasive species.

NOX–1: Development of a noxious weed management plan that includes pre-construction surveys, education of construction and operation personnel during construction and operation activities, the washing of vehicles and equipment before entering and leaving the GHPA, herbicide spraying, and annual monitoring. Survey information collected during pre-construction surveys would include species name, GPS location of weed infestations, percent cover, and approximate size of weed infestations. Control of noxious and invasive species would be consistent with the Vegetation Treatments on Public Lands Administered by the BLM in the Western U.S. (BLM 2007b), and could include chemical, mechanical, and biological methods. Herbicide treatment methods also would be consistent with BLM (2007c) guidance. It is recommended that the Fremont County Weed and Pest be consulted in the development of the noxious weed management plan.

NOX-2: Cheatgrass control methods on BLM-administered lands would be determined in consultation with the BLM and would focus on preventing the further spread of cheatgrass into areas disturbed by the Project.

Implementation of mitigation measure NOX-1 would provide more detail on existing noxious weeds of concern in the GHPA, and would provide specific methods for management of noxious weeds. In addition, it would provide a more accurate method of measuring success of weed treatments and would allow for flexibility in control methods. The focus of the weed management plan would be to address general weed prevention and control methods to be implemented pre-, during, and post-construction. Implementation of NOX-2 would assist in preventing the spread of cheatgrass into areas disturbed by the Project.

Residual Impacts

Implementation of the additional mitigation measure would reduce residual impacts from noxious weeds and invasive species. However, noxious weed and invasive species could persist over the long term regardless of the implementation of control programs.

4.13.2.3 Special Status Plant Species

The following impact assessments focus on special status plant species, which include those species federally listed as threatened, endangered, proposed, or candidate species, as well as BLM-sensitive species with the potential to occur within the GHPA. These species are identified in Section 3.13.3, Special Status Plant Species. Field surveys for the special status plant species were conducted in mid- to late June 2010, in the GHPA in areas of modeled habitat for each species (HWA 2011a) and in July 2011, within 0.25 mile of the Gas Hills Road upgrade ROW.

Persistent Sepal Yellowcress

Potential habitat for persistent sepal yellowcress was modeled as occurring north of Mine Unit 3, but still within the GHPA. During field surveys conducted in 2010 and 2011, in the modeled habitat areas in the GHPA, no populations of this species were observed (HWA 2011a,b). However, during field surveys conducted in 2011 along the Gas Hills Road upgrade ROW, suitable habitat for the persistent sepal yellowcress was observed (HWA 2011b). The majority of direct impacts to the suitable habitat for this species would be avoided because the location of the habitat is outside areas that would be impacted by surface-disturbing activities associated with the development of mine units under the Proposed Action. Direct impacts to suitable habitat could occur during the upgrade of the Gas Hills Road. Indirect impacts to the suitable habitat could include the spread of noxious and invasive weed species, fugitive dust, and potential changes in surface flow related to construction and operation activities. These indirect impacts

would be mitigated through the implementation of applicant-committed environmental protection measures (Section 2.3.9, Applicant-committed Environmental Protection Measures).

Cedar Rim Thistle

Potential habitat (587 acres) for the species was modeled as occurring in Mine Units 1 through 4. (HWA 2011a). No populations of Cedar Rim thistle were observed during field surveys in the modeled habitat; however, suitable habitat was observed among the clay slopes and fans within stands of Wyoming big sagebrush and grasslands in the vicinity of the Beaver Rim (HWA 2011a,b). A known location of Cedar Rim thistle occurs 2 miles southwest of the GHPA. Development of Mine Units 1 through 4 could potentially result in direct impacts to the suitable habitat for this species. Indirect impacts to the suitable habitat could include the spread of noxious and invasive weed species and fugitive dust. Indirect impacts would be mitigated through the implementation of applicant-committed environmental protection measures (Section 2.3.9, Applicant-committed Environmental Protection Measures).

Beaver Rim Phlox

No populations of Beaver Rim phlox were observed during field surveys; however, suitable habitat for the species was observed along the slopes and top of the Beaver Rim in gaps among the Wyoming sagebrush (HWA 2011a,b). This identified habitat occurs in the GHPA in areas of moderate to steep slopes. As the suitable habitat is located outside areas where surface-disturbing activities associated with the Proposed Action would occur, direct impacts to the suitable habitat would be avoided. Indirect impacts to the suitable habitat could include the spread of noxious and invasive weed species and fugitive dust. These impacts would be mitigated through the implementation of applicant-committed environmental protection measures (Section 2.3.9, Applicant-committed Environmental Protection Measures).

Rocky Mountain Twinpod

Potential habitat (2,592 acres) for the species was modeled as occurring within all mine units. No populations of Rocky Mountain twinpod were observed during field surveys; however, suitable habitat was observed along the north slope of the Beaver Rim (HWA 2011a,b). Direct impacts to the observed locations of suitable habitat for this species would be avoided because the location of the habitat is outside areas that would be impacted by surface-disturbing activities associated with the Proposed Action. Indirect impacts to the observed locations of suitable habitat could include the spread of noxious and invasive weed species and fugitive dust. These impacts would be mitigated through the implementation of applicant-committed environmental protection measures (Section 2.3.9, Applicant-committed Environmental Protection Measures).

Limber Pine

Within the GHPA, limber pine was observed in small stands in the higher elevations atop the Beaver Rim and east towards the Rattlesnake Hills (HWAa,b). Direct impacts to the suitable habitat for this species would be avoided as the location of the habitat is outside areas that would be impacted by surface-disturbing activities associated with the Proposed Action. Indirect impacts to the suitable habitat could include the spread of noxious and invasive weed species, fugitive dust, and fragmentation of species habitat. These indirect impacts would be mitigated through the implementation of applicant-committed environmental protection measures (Section 2.3.9, Applicant-committed Environmental Protection Measures).

Mitigation

The following mitigation measures are proposed to further avoid, minimize, or mitigate Project-related impacts to special status plant species.

SSP-1: Perform pre-construction surveys for persistent sepal yellowcress, Cedar Rim thistle, and Rocky Mountain twinpod in identified habitat (HWA 2011a,b) 1 year prior to development of

each mine unit and associated access roads within the modeled habitat boundary. Locations of any populations or individuals of Persistent sepal yellowcress, Cedar Rim thistle or Rocky Mountain twinpod identified during pre-construction surveys would temporarily be flagged during construction. Surface disturbance would not occur within 100 feet of any identified individuals or populations.

Implementation of mitigation measure SSP-1 would minimize or avoid direct impacts to any populations of persistent sepal yellowcress, Cedar Rim thistle, and Rocky Mountain twinpod that potentially may occur in the GHPA. Implementation of mitigation measures, VEG-1, VEG-2, and NOX-1 would minimize indirect impacts to any populations of persistent sepal yellowcress, Cedar Rim thistle, and Rocky Mountain twinpod.

Residual Impacts

Implementation of the additional mitigation measures would minimize impacts on special status plant species populations and suitable habitat.

4.13.3 Resource Protection Alternative

Under the RPA, construction of the Project would directly impact or remove a total of 818 acres of vegetation. **Table 4.13-4** identifies acreage of Project-related disturbance by vegetation community type for construction and operation activities associated with mine components and related infrastructure. Under this alternative surface disturbance would be reduced, as only half of each mine unit surface area would be disturbed from construction activities. Surface disturbance also would be reduced through the use of the closed loop drilling system, the reduced number of evaporation ponds, and by annual development planning. The closed loop drilling system eliminates the excavation of drilling mud pits, while annual development planning would identify procedures to constrain surface disturbance to identified areas. The amount of surface disturbed at one time would be reduced by the addition of construction timing constraints which would not allow construction of Mine Units 3 through 5 until successful reclamation was demonstrated on the mine unit developed 2 prior (e.g., Mine Unit 3 would not be developed until interim reclamation of Mine Unit 1 has been shown to make significant progress toward meeting reclamation success criteria).

4.13.3.1 Vegetation

Impacts from the RPA would be the same as described for the Proposed Action, except there would be a decrease in the acreage of shrub-dominated vegetation and wetlands impacted by the construction and operation activities. Construction and operation activities under the RPA would result in the long-term loss of 458 acres of shrub-dominated vegetation and 8 acres of wetlands.

Interim and final reclamation would occur as described under the Proposed Action. Final reclamation goals under this alternative would be evaluated using the reclamation criteria established in the Draft Lander RMP (BLM 2011b), which are based on the USDA-NRCS ESDs for each mapped ecological site (USDA-NRCS 2011). The criteria for reclamation success are outlined in Section 2.4.7.1, Reclamation Success Criteria.

Mitigation

Mitigation measures VEG-1 and VEG-2 would be implemented for the RPA as described under the Proposed Action Alternative.

Residual Impacts

Residual impacts to vegetation resources would be the same for the RPA as described under the Proposed Action Alternative.

Table 4.13-4 Acreages of Affected Vegetation Communities under the RPA

Mine Component			Vegetation Communities							
			Bottomland Sagebrush (acres)	Disturbed Land (acres)	Mixed Sagebrush-grassland (acres)	Reclaimed Areas (acres)	Rough Breaks East (acres)	Rough Breaks West (acres)	Upland Grassland (acres)	Wetlands (acres)
Mine Units, Including Monitoring Well Rings	Mine Unit 1	Construction	10	-	52	-	<1	13	13	<1
		Operation	4	-	21	-	<1	5	5	<1
	Mine Unit 2	Construction	3	-	87	22	73	-	8	-
		Operation	1	-	34	9	29	-	3	-
	Mine Unit 3	Construction	-	25	17	3	-	10	-	-
		Operation	-	10	7	1	-	4	-	-
	Mine Unit 4	Construction	9	<1	91	2	27	-	-	8
		Operation	4	<1	36	<1	10	-	-	3
	Mine Unit 5	Construction	7	1	24	27	3	-	-	-
		Operation	3	<1	10	11	1	-	-	-
Project Infrastructure	Roads with Utility Corridors	Construction	28	25	111	15	4	19	6	<1
		Operation	5	4	20	3	<1	3	1	<1
	Disposal Wells	Construction	-	-	2	2	--	2	-	-
		Operation	-	-	1	1	--	1	-	-
	Satellite Building Central	Construction	-	-	-	-	-	-	-	-
		Operation	-	-	-	-	-	-	-	-
	Satellite Building West	Construction	-	-	-	-	-	-	-	-
		Operation	-	-	-	-	-	-	-	-
	Water Management	Construction	8	27	8	20	-	-	-	-
		Operation	8	27	8	20	-	-	-	-
	Topsoil Piles	Construction	<1	<1	2	<1	<1	<1	<1	-
		Operation	<1	<1	2	<1	<1	<1	<1	-
Total		**Construction**	**65**	**78**	**393**	**90**	**107**	**43**	**27**	**8**
		Operation	**24**	**42**	**137**	**45**	**41**	**13**	**10**	**3**

4.13.3.2 Noxious Weeds and Invasive Species

Under the RPA, direct and/or indirect surface disturbance-related impacts to noxious weeds and invasive species would be approximately 818 acres. Anticipated impacts and recovery timeframes would be the same as described for the Proposed Action Alternative. As part of this alternative, Cameco would be required to submit and comply with the requirements of a noxious weed plan as described in Section 2.4.7.1, Reclamation Success Criteria.

Mitigation

Because Cameco would submit and comply with the requirements of a noxious weed plan under the RPA, only mitigation measure NOX-2 would be proposed by the BLM for this alternative.

Residual Impacts

Residual impacts to noxious weeds would be the same for the RPA as described under the Proposed Action Alternative.

4.13.3.3 Special Status Plant Species

Under the RPA, direct and/or indirect surface disturbance-related impacts to special status species would be approximately 818 acres. Anticipated impacts and recovery timeframes would be the same as described for the Proposed Action Alternative. The potential for impacts to occur would be reduced proportionately due to the reduction in surface disturbance compared to the Proposed Action.

Mitigation

Mitigation measures for special status plant species would be the same for the RPA as described under the Proposed Action Alternative.

Residual Impacts

Residual impacts to special status plant species would be the same for the RPA as described under the Proposed Action Alternative.

4.13.4 Irreversible and Irretrievable Commitment of Resources

If interim and final reclamation is successful, no irreversible commitment of resources would be anticipated for native vegetation communities. The loss of vegetation during construction and prior to reclamation would be irretrievable.

In areas with soil reclamation constraints, where interim reclamation might not be successful, there would be an irretrievable loss of native vegetation communities due to construction activities. If successful reclamation was not achieved, disturbed areas no longer would support native vegetation communities and potentially could be dominated by noxious and invasive weed species, especially halogeton and cheatgrass species. This would represent an irreversible and irretrievable commitment of this resource.

4.13.5 Relationship between Local Short-Term Uses and Long-Term Productivity

For all alternatives, long-term impacts that could affect long-term productivity include the disturbance of herbaceous and shrub-dominated vegetation cover types that would require up to 20 years to recover, and the potential that populations of weedy annual species (e.g., halogeton) could become established in localized areas for extended periods of time. Under all alternatives, the disturbance of herbaceous and woody-dominated vegetation community types would occur.

The decrease in vegetation cover types either through direct impacts (i.e., removal of vegetation) or indirect impacts (i.e., the spread of noxious and invasive species) could impact ecological function, livestock and wildlife grazing, and recreation activities in the GHPA.

4.14 Visual Resources

This section describes potential visual impacts associated with the Project and alternatives. The area evaluated for visual effects encompasses the viewshed of the Project, the area from which project features would be visible, most of which is within approximately 5 miles of the GHPA (**Figure 4.14-1**). As illustrated in **Figure 4.14-1**, visibility of Project features would be greatest within the GHPA and nearby to the northwest. Terrain, particularly the Beaver Divide, limits visibility of the GHPA from the east and south. Issues associated with visual resources that were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process included potential impacts to recreational users. No issues related to visual resources were identified from public comments submitted during the scoping process.

Impacts to visual resources were analyzed using the procedures outlined in the BLM Visual Contrast Rating Handbook H-8431-1 (BLM 2007d). Visual impacts were determined by comparing visual contrast ratings for the Project facilities with the VRM class objectives for the GHPA, which is designated VRM Class IV (see **Table 3.14-1**). The process involves comparing the degree of visual contrast from the proposed facilities and activities with the existing landscape character both during active recovery and after completion of reclamation. The contrast rating process used one Key Observation Point (KOP) as the viewpoint for conducting the impact analysis.

The KOP used in this analysis is located on Dry Creek Road approximately 0.3 mile west of the east section line of Section 18, T33N, R89W (**Figure 4.14-1**). The visual contrast rating worksheet for this location is included as **Appendix G**. Dry Creek Road is the nexus of the 3 main access roads to the Project vicinity: Wyoming State Route 136 from Riverton; Gas Hills Road (CR 212) from U.S. 20/26 at Waltman; and the Ore Road (CR 5) from U.S. 287 at Jeffrey City. While none of these roads is heavily traveled, the confluence of the 3 onto Dry Creek Road suggests it is a location from which the most viewers are likely to see the GHPA. The particular location of the KOP affords a relatively unobstructed view up the WCC valley toward Mine Unit 2 on the north slope of Beaver Divide. Traffic in the area is rural in nature, and generally is generated by local mineral development or ranching activity; however, some traffic may be generated by recreational activities including hunting, OHV use, or, on rare occasions, hiking.

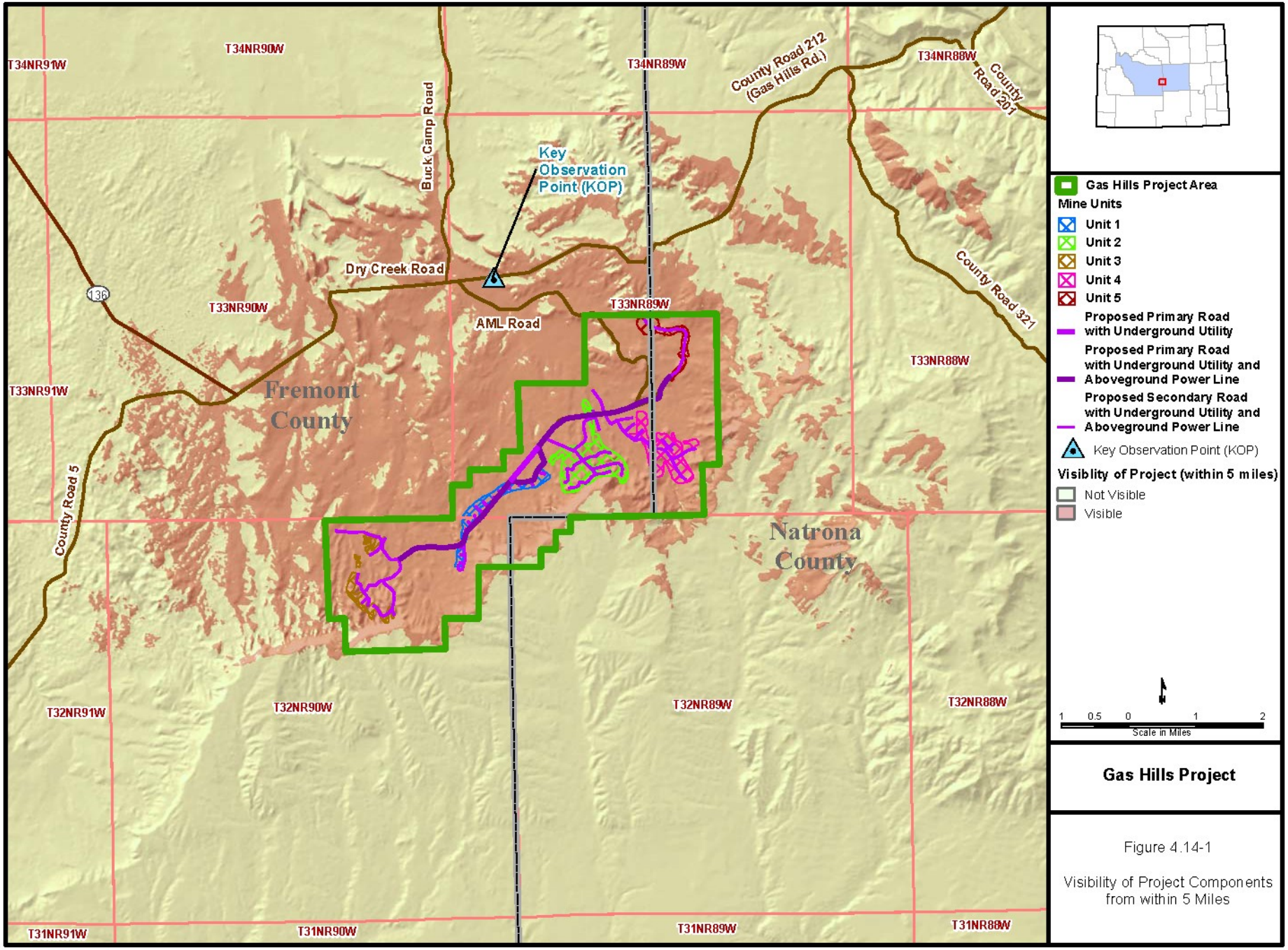
Potential impacts to visual resources were identified using the assumption that vegetation monitoring would be conducted as described in Section 2.3.7, Temporary Closures. This should be sufficient to assure successful reclamation of disturbed areas.

4.14.1 No Action Alternative

Under the No Action Alternative, in-situ uranium mining activities and the associated new facilities would not be developed within the GHPA. Currently authorized activities would continue and impacts to visual resources would be minimal.

4.14.2 Proposed Action Alternative

Development of the Proposed Action would result in a generally regular pattern of injection and production well heads interspersed with a number of medium-sized header houses in each mine unit. There would be a network of gravel surface and 2-track native surface roads, buried pipelines, pump stations, aboveground power lines, and ancillary facilities in each mine unit. The perspective from the selected KOP looks across Mine Unit 2 and part of Mine Unit 4 at a distance of approximately 2 to 3 miles. The visual effect of the Proposed Action would appear primarily as a textural change with the relatively small well head features spread across the landscape and the header houses and pump stations showing as larger, rectangular structural elements dispersed among the well heads. The pattern of well heads would show as a medium to coarse texture at the 2- to -3 mile viewing distance, providing a moderate contrast with the relatively fine texture of the existing landscape.



Gas Hills Project

Figure 4.14-1

Visibility of Project Components from within 5 Miles

Access roads and pipelines would introduce horizontal lines on the native ground surface; power lines would be most apparent for their strong vertical pole elements and sometime reflective conductors. The new surface linear features would be similar to existing roads, but the network would be noticeably more dense than the existing condition, providing a weak to moderate quantitative, rather than qualitative, visual contrast. The power lines would be strung on wooden single-pole structures, which would introduce moderate line contrast because of their vertical nature, although most would be at a sufficient distance from the KOP and other public viewpoints that they would not be visually prominent.

The greatest visual contrast from the Proposed Action would occur during construction, and again during decommissioning, when the greatest amount of surface disturbance would occur. Essentially the entire surface of each mine unit would be progressively disturbed over a period of 2 to 3 years during construction. There would be no discernible change to the existing land form from the project. During the construction and decommissioning, natural vegetation would be removed in patterns likely to be more geometric in form than the natural vegetative patterns. Exposure of the lighter colored soils would result in weak color contrast with the existing soil and vegetation colors during most seasons of the year with possible moderate color contrast during the spring and early summer when the green hues of the existing landscape are most prominent. These would be relatively short-term impacts that would recede as interim reclamation replaced disturbances with vegetation comparable to the native plant materials within approximately 3 to 5 years of the disturbance. The relatively flat terrain closest to the KOP would help minimize the visual effect to the KOP because of the low viewing angle while any disturbance on the slopes rising to the Beaver Divide would provide a more noticeable, direct viewing angle that would be partially mitigated by the greater distance from viewers.

After successful completion of interim reclamation activities, there would be minor vegetative form and color contrast effects. Linear features, which would represent most of the unreclaimed disturbance area, would introduce moderately stronger visual contrast. The textural change from the evenly spaced Project facilities would be the most apparent visual effects to viewers during most of the projected 25-year life of the Project, although it would be considered moderate because the facilities would employ colors compatible with the natural landscape, would be relatively small in scale, and would not dominate the view, particularly as seen from the KOP.

The significance of the visual impacts as seen from the KOP would be considered low. Project features would attract the attention of the casual observer, but would not dominate the view and would conform to the VRM Class IV management guidelines for the area.

Mitigation

The following additional measures to avoid, minimize, or mitigate impacts to visual resources are proposed.

VRM-1: Pursuant to the VRM Class IV management objective indicating that visual effects should be minimized to the extent possible, aboveground facilities would be painted with low-reflectivity paints in colors that would blend with the natural environment. The BLM color chart provides a tool for use in selecting an appropriate paint color or colors.

Implementation of mitigation measure VRM-1 would minimize impacts to the degree possible, in compliance with the requirements of VRM Class IV management objectives.

Residual Impacts

Adverse visual effects from the Proposed Action would be minimized by application of the mitigation measure discussed above and by successful reclamation of surface disturbance to the point that casual observers would be unlikely to recognize that there had been activity related to the Project.

4.14.3 Resource Protection Alternative

The RPA would reduce the amount of surface disturbance, compared to the Proposed Action, both during construction and, subsequently, during decommissioning when some underground facilities would be left in place to avoid re-disturbing those areas. It also would result in enhanced reclamation with the objective of returning the disturbed area to enhanced vegetative conditions relative to existing conditions. Approximately 21 miles of new power lines needed to service the ISR mining activities would be placed underground rather than overhead. This would greatly reduce or eliminate the vertical line contrast from power poles in the mine GHPA.

The RPA would result in a reduction in visual contrast compared with the Proposed Action. Under this alternative, the visual effects would be considered low and somewhat lower in intensity than under the Proposed Action. The degree of visual change would conform to the VRM Class IV management guidelines for the area. From a visual resources perspective, the RPA would be more consistent with the directive that “every attempt should be made to minimize the (visual) impact …” in VRM Class IV areas.

Mitigation

Mitigation measures for the RPA would be the same as for the Proposed Action.

Residual Impacts

Residual impacts would be the same as for the Proposed Action.

4.14.4 Irreversible and Irretrievable Commitment of Resources

Previously described impacts to visual resources would be reversible through reclamation efforts; reestablishment of plant communities would require a minimum of 3 to 5 years and is further discussed in Section 4.13, Vegetation.

4.14.5 Relationship between Local Short-Term Uses and Long-Term Productivity

Project components, such as structures, piping, evaporation ponds, power lines and access roads, would be removed at the end of their life spans and the land would be reclaimed to pre-existing or enhanced conditions. These actions would minimize impacts to the long-term productivity and sustainability of public land resources.

4.15 Water Resources

This section evaluates potential impacts to water resources from the Gas Hills Project. The following subsections separately present a discussion of impacts to surface water (Section 4.15.1, Surface Water Resources), groundwater (Section 4.15.2, Groundwater Resources), and water use (Section 4.15.3, Water Use).

4.15.1 Surface Water Resources

The analysis area used for assessing potential impacts to surface water resources is defined as all 6th order, 12-digit HUC-12 Subwatersheds (USDA-NRCS et al. 2010) that have a portion of the GHPA included within their boundary (**Table 3.15-1** and **Figure 3.15-1**) and have surface disturbance proposed by the Project. A total of 4 subwatersheds have a portion of the GHPA within them; however, only the 2 within the Big Horn Basin have Project-related surface disturbance proposed within them and are assessed in the surface water resources analysis. The surface water resources analysis area encompasses over 61,000 acres or approximately 96 square miles.

Primary issues associated with surface water resources were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process. These include potential impacts to surface water quality and quantity such as increased erosion, increased sediment loads or turbidity, increased salinity, increased use of water, and contamination from produced water or other hazardous substance spills.

Impacts to surface water quality were analyzed by determining proposed surface disturbance within each watershed and evaluating the potential for erosion and sedimentation issues. This evaluation included quantification of the number, location, and type of existing and proposed roads crossing waterways. The potential for contamination of surface water from hazardous substance spills and from accidental release of process water also is discussed.

For the purposes of analyzing the number of stream crossings, it was assumed that the National Hydrography Dataset accurately defines the location of waterways that would require a culvert crossing. Any identified issues with consumptive use of water would be resolved through W.S. 41 (WSEO) policies and procedures.

4.15.1.1 No Action Alternative

Current management in the Analysis Area would be maintained under the No Action Alternative. Under this alternative, no project construction or operation would occur. The Carol Shop facility, 1 road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres; reclamation would restore surface contours to approximate original drainage patterns. Continued exploration activities would continue within the GHPA under existing management at a rate of 5 acres or less each year, and reclamation of these sites would be anticipated to occur within the same calendar year as the disturbance. There would be no potential for a hazardous material spill.

4.15.1.2 Proposed Action Alternative

Under the Proposed Action Alternative, Cameco would construct wells, roads, pipelines, evaporation ponds, and surface facilities on approximately 1,315 acres throughout the GHPA. During construction and operation, potential impacts could include increased runoff and erosion from disturbed lands, increased stream channel instability from road crossings, and potential degradation of surface and groundwater quality due to spills of hazardous materials from construction equipment. Surface disturbance during construction of the Project components would have the potential to impact surface water sources by increasing runoff, erosion, and downstream sedimentation.

Mine Units 2, 4, and 5, and the proposed evaporation ponds would be located within the Upper Canyon Creek-Deer Creek Subwatershed, where the major stream is WCC (**Figure 4.15-1**). Mine Unit 3 would be within the Fraser Draw Subwatershed, and Mine Unit 1 would be located within both the Upper Canyon Creek-Deer Creek and the Fraser Draw subwatersheds.

Surface disturbance from Project construction within Upper Canyon Creek-Deer Creek and Fraser Draw subwatersheds would represent 4.8 and 0.6 percent of the total subwatershed areas, respectively. Operational disturbances in the affected sub-watersheds are 0.9 and 0.1 percent of the Upper Canyon Creek-Deer Creek and Fraser Draw subwatersheds, respectively. This disturbance is detailed in **Table 4.15-1** and depicted in **Figure 4.15-1**. Construction activities would remove vegetation cover from disturbed areas, resulting in an increase in runoff. Soil disturbance by mechanized equipment along with the removal of vegetation would result in an increase in soil erosion from disturbed areas. Both of these impacts collectively would result in the potential for sedimentation within ephemeral and perennial (WCC) drainages within and downstream of disturbed areas.

The Project potentially would impact 15 acres of wetlands along WCC in Mine Unit 4, including the perennial reaches of the creek. Impacts to wetlands are discussed in more detail in the vegetation impact analysis in Section 4.13, Vegetation. All disturbance associated with construction within streams or wetlands would require that jurisdiction of wetlands impacted by development on Mine Unit 4 would be determined in consultation with the USACE as described in Section 4.13.2.1, Vegetation. In addition, the applicant would develop a mitigation plan for impacts to the wetlands that would be approved by the WDEQ-LQD, BLM, and USACE. As jurisdictional status of the wetlands and the mitigation to be developed with the USACE is unknown, it is assumed, for the impact analysis, that the Project has the potential to impact wetlands in Mine Unit 4.

The portion of disturbance within the Canyon Creek-Deer Creek and Fraser Draw subwatersheds that would be associated with the evaporation ponds, drainage diversion, and runoff control berm was designed to isolate process water within the ponds and to divert storm runoff from disturbed areas (diversions and berms). The evaporation ponds would be hydrologically isolated using below-grade, synthetically lined, bermed impoundments with a secondary liner and leak detection system. The ponds would be constructed in pairs, and each in the pair would be designed to contain the combined maximum operating capacity of both of the paired ponds to allow for drain-down of 1 pond for any necessary maintenance. A minimum freeboard of 2 feet also would be incorporated, allowing for wind and wave action as well as storage in the event of high intensity precipitation.

Under this alternative, 16 culverts would be installed in roads at waterway crossings, all within the Upper Canyon Creek-Deer Creek subwatershed. There are 10 locations where proposed roads would cross ephemeral streams and 6 locations where a perennial stream (WCC) would be crossed. These crossings could alter the existing channel geometry which could potentially increase water velocities and decrease bank stability. In addition, channel stability could be further decreased by removing bed and bank vegetation, and by culvert installation which could result in changes to channel roughness and gradient. The GHPA experiences high levels of variability in channel processes (i.e., headcutting, bank failure, sedimentation) under natural and existing conditions, and that variability could be further exacerbated by Project development. The majority of these channels generally are dry (ephemeral/intermittent) except during the most intense precipitation periods (e.g., 10-year precipitation events or greater).

Localized channel processes during high flows and in response to changes in channel geometry and upland/riparian vegetation normally include head-cutting, bank failure, channel sedimentation, and channel scour. Construction disturbance near or across drainage channels and streams likely would exacerbate these processes, especially in areas with highly erodible soil types (see Section 4.11, Soils, for discussion of potential impacts to highly erodible soils), by decreasing the vegetative cover and damaging the soil structure that limits erosion under existing conditions.

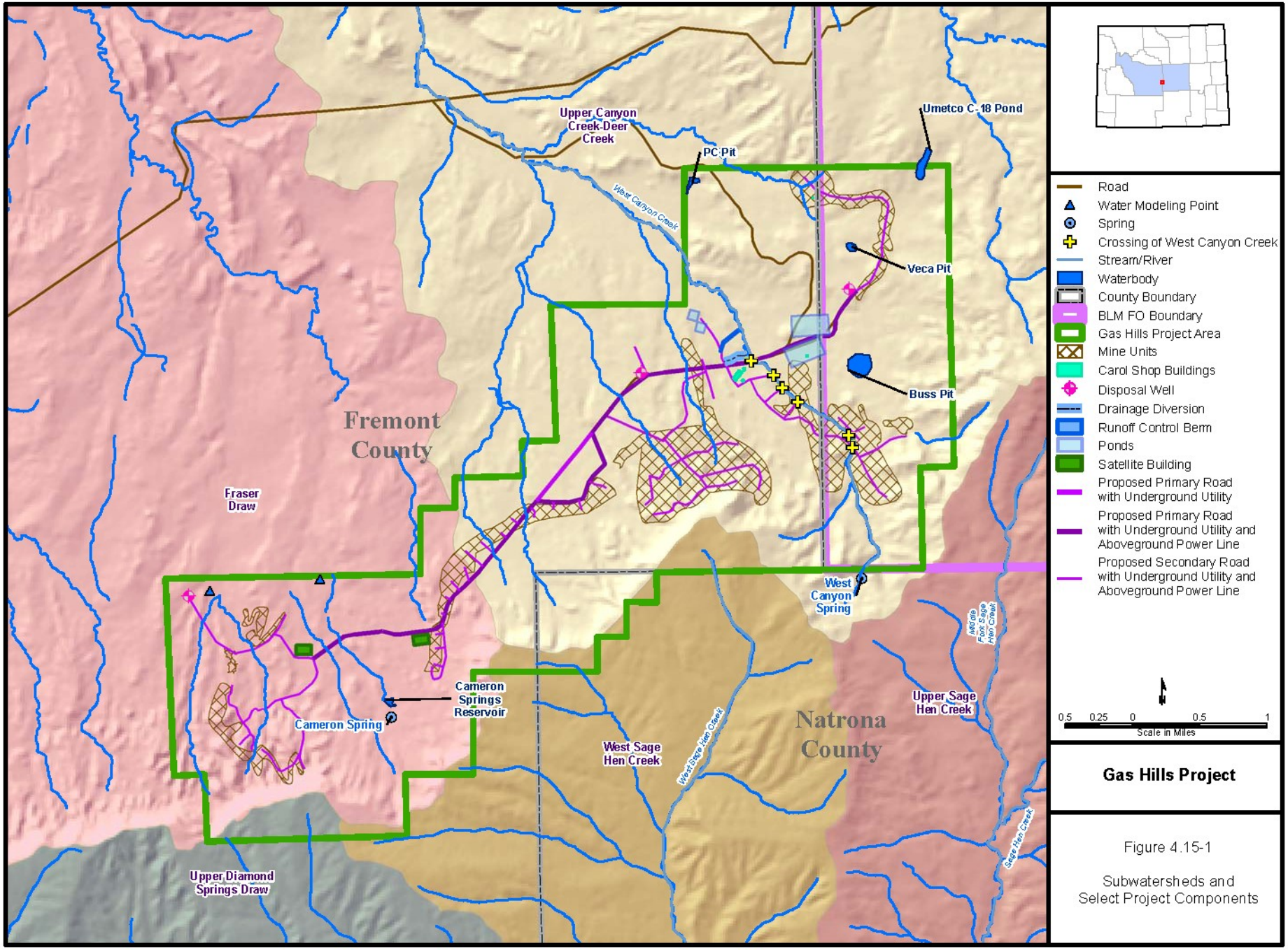


Figure 4.15-1

Subwatersheds and Select Project Components

Table 4.15-1 Surface Disturbance under the Proposed Action Alternative by Subwatershed

Project Facility	Upper Canyon Creek-Deer Creek Subwatershed				Fraser Draw Subwatershed			
	Construction		Operation		Construction		Operation	
	(acres)	(percent)[a]	(acres)	(percent)[a]	(acres)	(percent)[a]	(acres)	(percent)[a]
Mine Unit 1	96	0.4%	48	0.2%	60	0.2%	30	0.1%
Mine Unit 1 Monitoring Well Ring	6	<0.1%	6	<0.1%	5	<0.1%	3	<0.1%
Mine Unit 2	365	1.7%	183	0.8%	0		0	
Mine Unit 2 Monitoring Well Ring	10	0.0%	10	0.0%	0		0	
Mine Unit 3	0		0		90	0.2%	45	0.1%
Mine Unit 3 Monitoring Well Ring	0		0		10	<0.1%	5	<0.1%
Mine Unit 4	255	1.2%	128	0.6%	0		0	
Mine Unit 4 Monitoring Well Ring	9	<0.1%	9	<0.1%	0		0	
Mine Unit 5	111	0.5%	56	0.3%	0		0	
Mine Unit 5 Monitoring Well Ring	8	<0.1%	8	<0.1%	0		0	
Ponds, Drainage Diversion, Runoff Control Berm	62	0.3%	62	<0.1%	0		0	
Process Water Pipeline	8	<0.1%	0		0		0	
Road ROW[b]	120	0.6%	23	<0.1%	80	0.2%	40	0.1%
Satellite Building Central	0		0		5	<0.1%	3	<0.1%
Satellite Building West	0		0		5	<0.1%	3	<0.1%
Topsoil Piles	1	<0.1%	1	<0.1%	2	<0.1%	1	<0.1%
Total	**1,051**	**4.8%**	**533**	**2.4%**	**256**	**0.6%**	**129**	**0.3%**

[a] Reported as percent of total subwatershed area (from **Table 3.15-1**, the total area of Upper Canyon Creek-Deer Creek is 21,810 acres and Fraser Draw is 39,558 acres).

[b] Includes utility construction disturbance.

Note: Differences in totals are due to rounding.

Implementation of applicant-committed measures (ACMs) and BMPs would minimize the impacts of surface disturbance to water resources. Within the state-required SWPPP (SWPPP, Addendum OP-4 to the mine permit application [PRI 2009]), the applicant has committed to minimizing erosion impacts through the use of erosion control and channel stabilizing measures (e.g., ditches and berms, conveyance channels, rock/rip rap, outlet protection, sediment traps or basins, straw bale barriers, silt fence, check dams).

Storm water management would be implemented as defined in the SWPPP, which includes monitoring and maintenance of all control devices and structures during active construction on 1 of 2 schedules; at least once every 14 days, and within 24 hours of a precipitation event greater than 0.5 inches. After active construction is finished but before complete reclamation has occurred, these structures and devices would be inspected a minimum of once per month with the exception of extended periods of frozen ground conditions over the entire site. If unacceptable erosion impacts are discovered during inspections, additional BMPs would be employed to mitigate the impacts.

Impacts from disturbance in upland locations would be minimized through the use of erosion control devices (e.g., silt fences, straw bales, berms, mulches, soil binders, erosion control blankets). See Section 2.3.9, Existing Monitoring Plans, for applicant-committed erosion measures for specific erosion control devices.

Potential spills of hazardous materials from construction or operation equipment would be addressed in the Project's SPCCP, which would be developed prior to Project initiation. This plan includes measures such as secondary containment at all on-site hazardous materials and waste storage facilities, including fuel. The SPCCP also defines procedures to be followed in the case of an accidental spill from a vehicle or equipment. No degradation to water quality would be anticipated.

Potential spills of mine unit fluid would be minimized through proper construction and operational procedures, proper training of personnel, and leak detection devices and alarms. The procedures to be followed in the case of a spill of this type would be similar to those for the Smith Ranch-Highland facility, addressed in the SHEQ Management System Emergency Procedures Volume VIII of the SRH Uranium Project (PRI 2011a), because the Project would be operated as a satellite to the SRH Project. The potential for impacts to water quality remain; however, adequate leak detection devices and alarms could minimize these impacts.

There also is a potential spill hazard during transport of resin that could affect water quality at river crossing locations along the transportation route to Smith Ranch-Highland facility. The main crossings of concern are the North Platte River in Casper and near Douglas. According to analyses contained in Section 4.8, Public Health and Safety, the risk of accidents at these 2 North Platte River crossings (assuming a conservative 1-mile crossing at each) during product shipment would have a probability of occurring 0.006 times in the projected 25-year life of the Project (see Section 4.8, Public Health and Safety, for additional information on risk of traffic incidents).

Mitigation

The following mitigation measures would be applied to further avoid, minimize, or mitigate Project-related impacts to surface water.

SWR-1: Cameco would submit details of the proposed types and locations of the mine unit fluid spill detection devices and alarms to the BLM for review and approval.

Implementation of SWR-1 would allow the most current technology to be used to limit the potential for surface leaks of lixiviant or pregnant solution from ISR well heads within the mine units. Implementation of VEG-1 (Section 4.13.2.1, Vegetation) would eliminate disturbance within wetlands along WCC and would ensure implementation of erosion and sediment BMPs described in the SWPPP (PRI 2011a) within 500 feet of wetlands. Mitigation measure VEG-1, by eliminating road crossings and culvert

installation within wetlands along WCC would reduce the potential of the Project to exacerbate in-channel processes such as headcutting, bank failure, and sedimentation. This mitigation measure would eliminate 3 of the 6 proposed road crossings of WCC within Mine Unit 4. Access to portions of Mine Unit 4 located north and east of WCC could be maintained via the remaining 3 crossings.

Properly implemented BMPs, ACMs, and mitigation measures, used during construction and operation, would minimize impacts of surface disturbance on water quality and quantity; therefore, significant impacts would not be anticipated.

Residual Impacts

No significant impacts would be anticipated to water resources from the Project, and therefore, residual impacts also would not be anticipated.

4.15.1.3 Resource Protection Alternative

The types of impacts to surface water resources under the RPA would be similar to those under the Proposed Action, with the following exceptions. Disturbance for mine unit construction would be reduced, and travel patterns used during operation would be planned to avoid sensitive areas with greater potential to contribute to runoff and sedimentation. Disturbance would be distributed within the same watersheds as described for the Proposed Action (**Figure 4.15-1**) but would be reduced as detailed in **Table 4.15-2**. These changes would reduce potential impacts to drainage patterns, as well as to surface water resources. With proper implementation of ACMs and BMPs during construction and operation, significant impacts would not be anticipated.

The reduction of heavy truck trips used to transport uranium slurry to the Smith Ranch-Highland facility to 122 annual trips under the RPA from 325 annual trips under the Proposed Action would decrease the potential for spills of that material, and would reduce the potential of a release at highway river crossings to approximately 0.002 times in the projected 25-year life of the Project (see Section 4.8, Public Health and Safety, for additional information on risk of traffic incidents).

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No residual impacts would be anticipated.

4.15.1.4 Irreversible and Irretrievable Commitment of Resources

Irreversible impacts to surface water are not anticipated since properly implemented ACMs and BMPs, including reclamation, would reduce effects on water quantity and quality over time. Temporary reductions in water quality from erosion, sedimentation, and spills of hazardous materials would be irretrievable during construction and until reclamation occurred.

4.15.1.5 Relationship between Local Short-term Uses and Long-term Productivity

Increases in erosion and decreases in bank vegetation could potentially impact channel stability during the life of the Project. However, properly implemented ACMs and BMPs would reduce the impacts to channel stability, and long-term effects would be minimized.

Table 4.15-2 Surface Disturbance under the RPA by Subwatershed

Project Facility	Upper Canyon Creek-Deer Creek Subwatershed				Fraser Draw Subwatershed			
	Construction		Operation		Construction		Operation	
	(acres)	(percent)[a]	(acres)	(percent)[a]	(acres)	(percent)[a]	(acres)	(percent)[a]
Mine Unit 1	48	0.2%	19	0.1%	30	0.1%	12	<0.1%
Mine Unit 1 Monitoring Well Ring	6	<0.1%	6	<0.1%	3	<0.1%	1	<0.1%
Mine Unit 2	183	0.8%	73	0.3%	0		0	
Mine Unit 2 Monitoring Well Ring	10	<0.1%	10	<0.1%	0		0	
Mine Unit 3	0		0		45	<0.1%	18	<0.1%
Mine Unit 3 Monitoring Well Ring	0		0		5	<0.1%	2	<0.1%
Mine Unit 4	128	0.6%	51	0.2%	0		0	
Mine Unit 4 Monitoring Well Ring	9	<0.1%	9	<0.1%	0		0	
Mine Unit 5	56	0.3%	22	0.1%	0		0	
Mine Unit 5 Monitoring Well Ring	8	<0.1%	8	<0.1%	0		0	
Ponds, Drainage Diversion, Runoff Control Berm	62	0.3%	62	0.3%	30	<0.1%	12	<0.1%
Process Water Pipeline	8	<0.1%	0	<0.1%	0		0	
Road ROW[b]	120	0.6%	23	0.1%	40	<0.1%	16	<0.1%
Satellite Building Central	0		0		3	<0.1%	1	<0.1%
Satellite Building West	0		0		3	<0.1%	1	<0.1%
Topsoil Piles	1	<0.1%	1	<0.1%	1	<0.1%	0	<0.1%
Total	**638**	**2.9%**	**284**	**1.3%**	**159**	**<0.1%**	**63**	**<0.1%**

[a] Reported as percent of total subwatershed area (from **Table 3.15-1**, the total area of Upper Canyon Creek-Deer Creek is 21,810 acres and Fraser Draw is 39,558 acres).

[b] Includes utility construction disturbance.

Note: Differences in totals are due to rounding.

4.15.2 Groundwater Resources

This section describes potential impacts to groundwater quality and quantity that could result from the Project. The groundwater impact analysis area during construction, operation, and reclamation is the GHPA, which corresponds to the maximum WDEQ-LQD permit boundary. The groundwater impact analysis area during groundwater restoration is the GHPA, plus the area within 10 miles of the GHPA boundary within which potential drawdown impacts could occur during groundwater sweep. Groundwater resources within the GHPA were identified by reviewing existing data sources, including available geology and hydrogeology data from state and federal agencies as well as from Cameco (PRI 2009). Available information was used to identify the extent to which the Project could impact groundwater, and also to identify crossover or conflicts with applicable land use plans and/or regulations.

Potential issues associated with groundwater resources were identified by the BLM through internal scoping, consultation with cooperating agencies, or through comments provided during the scoping process. These issues include:

- Impacts to water quantity and groundwater quality from the Project;
- Potential issues with restoring groundwater quality in the GHPA to pre-mining baseline water quality;
- The potential impact of approximately 12,000 abandoned exploration holes or wells currently existing within the GHPA, some of which may not have been properly plugged and abandoned;
- The potential impact on groundwater flow and quality due to faults, historic mine workings, and complexities in the stratigraphy of the Gas Hills District; and
- The potential for impacts to groundwater quality and quantity from deep disposal of wastewater.

Permitting and oversight of groundwater impacts for ISR mining is under the jurisdiction of the WDEQ-LQD. The following analysis of potential impacts of the Project and alternatives assumes that ISR activities would be conducted in accordance with the WDEQ-LQD mine permit.

4.15.2.1 No Action Alternative

Under the No Action Alternative, ISR mining of uranium in the GHPA would not take place. No change to current groundwater flow patterns and groundwater quality, discussed in Section 3.15.2, Groundwater Resources, would occur, and there would be no impacts to groundwater quantity or quality from the Project beyond those currently existing from past mining activity (see discussion of past mining impacts (Section 3.15.2.4, Hydrology of the Mine Units, Irreversible and Irretrievable Commitment of Resources).

4.15.2.2 Proposed Action Alternative

Under the Proposed Action, in-situ recovery of uranium would occur within 5 mine units within the GHPA, as described in Section 2.3, Proposed Action. The ISR process involves the introduction of a chemical solution, or lixiviant, into groundwater to remove uranium from the subsurface ore deposit. The process also involves injection and pumping wells which redirect groundwater flow to contain and remove the lixiviant. Collectively, these activities could impact groundwater as follows:

- Groundwater quality within mine units would be impacted by the injection of lixiviant to remove uranium from the ore deposit. This intentional impact would be reversed by the implementation of groundwater restoration following the extraction of uranium from the target ore zones.
- Groundwater quality outside of mine units could be impacted by excursions of lixiviant beyond the monitoring well ring around each mine unit. Initial testing results presented in Section 3.15.2, Groundwater Resources, indicate that faults within several of the mine units provide pathways for leakage of groundwater from target ore zones; that hydraulic communication with overlying confining zones is observed; and that interfingering of target ore zones results in hydraulic

communication between zones. These complexities in the subsurface hydrogeologic conditions suggest the potential for migration of lixiviant outside on mine units. Further hydrologic testing would be conducted (see Section 2.3.2.2, Hydrologic Testing) under WDEQ-LQD and U.S. NRC oversight to demonstrate containment of injected fluids.

- Migration of groundwater contaminated by past mining and milling activities may be affected during post mining groundwater restoration. In particular, Mine Unit 4 is located in close proximity to the Buss Pit (see **Figure 1-1**) which contains water impacted with high TDS from past mining activities. Mine Unit 5 is located next to several historic mine pits (including Veca, C-13, C-18, A-8 and Tee pits as shown in **Figure 3.15-4**) and in close proximity to the Gas Hills East Tailings Cap (also see **Figure 3.15-4**) to be managed under the DOE LM program. During groundwater restoration, wells within the mine units would be pumped without simultaneously injecting lixiviant in order to draw in native groundwater from outside of the mine unit. In the case of Mine Unit 4 and Mine Unit 5 this process could draw in or displace contaminated groundwater from past mining and milling activities.
- Groundwater quantity could be impacted by the removal of bleed water during ISR operations. Bleed water is removed from the ISR circulation process so that slightly more (about 1 percent) water is pumped than injected from a wellfield creating inward flow to a mine unit during operations. This would result in a general lowering of groundwater levels within a mine unit through removal of groundwater from aquifer storage and a reduction in available groundwater quantity until restoration of groundwater levels.
- Groundwater quantity temporarily could be impacted by drawdown during groundwater sweep activities associated with groundwater restoration.

These impacts to groundwater would be addressed through the WDEQ-LQD permitting and oversight process which requires monitoring and hydrologic testing of groundwater prior to implementing the ISR process and restoration of groundwater quality to pre-mining baseline water quality conditions. In the event that pre-mining baseline water quality could not be met for 1 or more specific constituents in a mine unit, continued restoration of the groundwater would be required until pre-mining Wyoming Class of Use for the groundwater had been met. The current Class of Use is Class III for livestock use.

ISR mining is regulated by the U.S. NRC because of the radioactive nature of the uranium ore and associated daughter products, and groundwater related to mining operations is regulated by the WDEQ-LQD within the State of Wyoming. The U.S. NRC (2002) established guidelines for the regulation of uranium ISR, and the WDEQ-LQD (2005a,b, 2000) adopted these guidelines as regulations to be followed in conducting ISR activities in Wyoming.

As described in Section 3.16.2, the proposed mine units for the Project would be located in areas with historic underground and open pit mines, faults, areas of elevated TDS water from historic mining, and areas of contaminated groundwater (metals, uranium, and radium) associated with past uranium milling activities. In addition, as described in Section 2.1, Existing Infrastructure and Disturbance in the Gas Hills Project Area, there are areas of abandoned drill holes, some of which may not have been properly plugged. These issues would be addressed for each mining unit through the hydrologic testing and reporting process that would be completed for each mining unit and submitted to the WDEQ-LQD for review prior to initiating ISR activities.

Monitoring and Determination of Impacts to Groundwater Quality

The main guidelines for ISR mining are found in the WDEQ-LQD Rules and Regulations, Chapter 11 (2005b), WDEQ-LQD Guideline Number 8 (2005a), and WDEQ-LQD Guideline Number 4 (2000). There are 5 main aspects to ISR addressed in the regulatory guidelines that WDEQ-LQD would use to determine impacts to groundwater quality:

1. Pre-mining water quality determination would be performed for the GHPA. This water quality data would be compared to data collected from monitoring wells during mine operation to determine if an excursion of lixiviant (defined as an exceedence of at least 2 key constituents at a monitoring well) has occurred. It also would be used during groundwater restoration to determine whether groundwater restoration had achieved pre-mining water quality.
2. Aquifer testing would be performed to establish the directional hydraulic properties of the production zone, hydrologic boundary conditions, possible vertical hydraulic connections with overlying or underlying aquifers, the potential effects of faults, abandoned mine workings, and improperly abandoned drill holes on the migration of the lixiviant. These characterizations would be used to determine the potential of the ISR process to affect water quality outside the mine unit. The characterizations also would be used to determine the potential for adjacent water bodies of adverse water quality to affect ISR mining or groundwater restoration.
3. Production unit water quality determination would compare pre-mining water quality in the mine unit production zone to groundwater collected from monitoring wells in the production zone both during mine operation and groundwater restoration as described in 1) above, but would be applied to the specific target aquifer associated with each mine unit.
4. Monitor well design would be specified for mining units to adequately reflect the directional transmissivity of the production zone, as well as monitor for any excursions into overlying and underlying aquifers that bound the production zone. The location, spacing, and design of monitor wells is covered in WDEQ-LQD Rules and Regulations, Chapter 11 (WDEQ-LQD 2005b), and would be specified by WDEQ-LQD after receipt and review of the hydrologic testing report for each mine unit.
5. WDEQ-LQD guidelines determine the post-mining restoration goals that would apply to each mine unit. For mine closure, groundwater quality would be required to meet 1 of the following conditions:
    a. Pre-mining baseline water quality;
    b. Pre-mining Class of Use; and
    c. WDEQ-LQD specified target levels for specific constituents.

WDEQ-LQD guidelines specify that the primary goal for groundwater restoration would be pre-mining baseline water quality. If pre-mining baseline water quality could not be met for 1 or more constituents (e.g., metals, TDS, radionuclides), the WDEQ-LQD could allow groundwater restoration to pre-mining Class of Use. If pre-mining Class of Use could not be met for 1 or more constituents, the WDEQ-LQD would determine what restoration activities would be required to meet specified target levels for those constituents.

During groundwater restoration, certain groundwater constituents could be more difficult than others to return to restoration target levels. If specific parameters do not achieve pre-mining baseline water quality concentrations, the WDEQ-LQD could approve the use of pre-mining Class of Use as the restoration target levels provided BPT has been applied. WDEQ-LQD Guideline Number 4 (2000) defines BPT for ISR groundwater restoration. The WDEQ-LQD would decide if BPT has been applied to a mine unit for the specific parameters not meeting the restoration target levels. In any case, if any constituent remains above the pre-mining Class of Use, restoration would be deemed unsuccessful and the WDEQ-LQD would determine further restoration using technologies specific to the remaining parameters not meeting the restoration target level. The WDEQ-LQD would have the final determination for groundwater restoration in a mine unit. As noted in **Figure 2-3**, production of Mine Unit 4 would not commence until groundwater restoration for Mine Unit 1 was shown to be successful. The WDEQ-LQD would review and approve the proposed schedule of mining and groundwater restoration for each mine unit prior to commencement of ISR mining.

Process for Determining Containment of ISR Fluids

Geological layers can be discontinuous as a result of shifts from faulting, variable layer thickness, differences in permeability of layers, or physical disruptions from activities such as open-pit mining or wells. These discontinuities can provide avenues for groundwater movement between geological layers, and can provide challenges to containment for ISR. Groundwater monitoring would be used to detect migration of the lixiviant outside mine units due to the presence of geologic discontinuities, or to detect migration of the historically contaminated groundwater toward a wellfield. Operational engineering procedures to avoid uncontrolled migration of lixiviant or existing groundwater contamination (PRI 2009) could include:

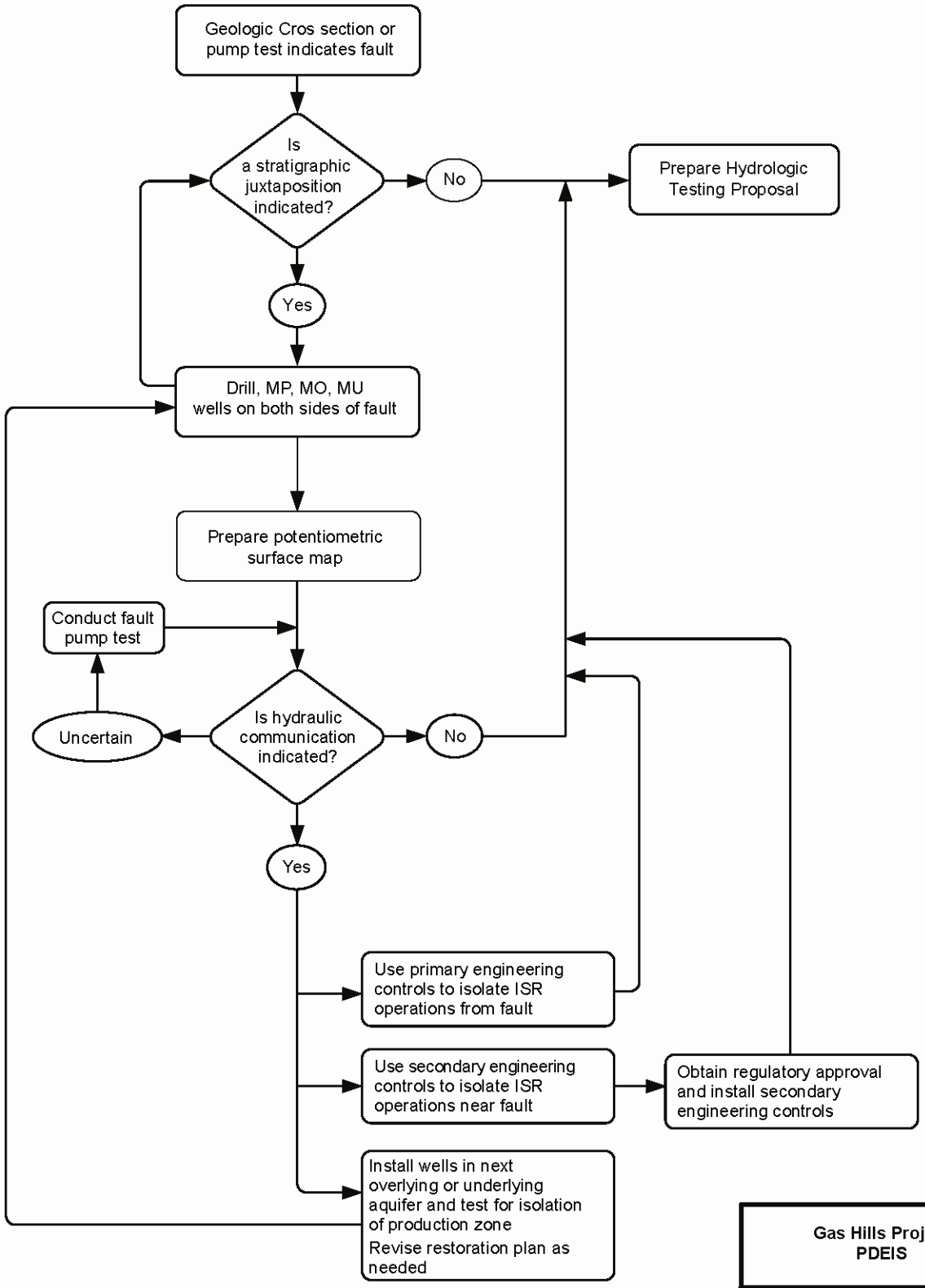
- Production area pattern balancing – increasing or decreasing the ratio of ISR injection wells to recovery wells to better control groundwater flow patterns;
- Pump scheduling – varying the timing and rate of water pumped into ISR injection wells and water removed from ISR production wells to control groundwater flow patterns;
- Wellfield set backs – distancing wellfields from a potential geological problem area;
- Monitoring well design – adjust monitoring well design to provide earlier detection of lixiviant excursions; and
- Water fences – a line of water injection wells used to produce a hydrologic barrier, or fence.

The decision tree shown in **Figure 4.15-2** illustrates the procedure to be followed to address concerns associated with groundwater interaction with faults within a mine unit. The primary procedure would be to determine if there was hydraulic communication between the fault and the production zone of the mine unit or communication with the overlying and underlying aquifers. If hydraulic communication or significant interaction between a fault and mine unit is indicated, engineering controls would be implemented to hydrologically isolate the ISR operation within the fault. The WDEQ-LQD would approve any engineering controls used to isolate a fault in a mine unit.

The decision tree shown in **Figure 4.15-3** would be followed to address concerns regarding historic groundwater contamination. Predicted movement of historic groundwater contamination would be used to determine potential interaction with the production wellfield. As with faults, engineering controls approved by the WDEQ-LQD would be used as needed to either control the movement of the historic contamination or prevent the migration of the contaminated water into the production zone. These same procedures would be used during groundwater restoration to keep the historic groundwater contamination out of the production zone. Because Cameco would be required to follow all applicable WDEQ-LQD and U.S. NRC guidelines that apply to both ISR mining of uranium and restoration of groundwater quality, no impacts to groundwater quantity or quality would be expected beyond the GHPA boundary. In addition, the WDEQ-LQD requirement to restore groundwater flow patterns (groundwater quantity) and groundwater quality to pre-mining conditions suggests that there would be no long-term impacts to groundwater from ISR injection and production activities.

Drawdown Impacts During Groundwater Sweep

During the groundwater sweep phase of groundwater restoration, water would be pumped from the wellfield to the processing plant through all production and injection wells without reinjection. This activity would pull relatively unaffected groundwater into each mine unit from surrounding areas, and could potentially increase the depth to groundwater (drawdown) beyond the GHPA as a result of pumping during the groundwater sweep. Conservative analysis using a simplified one-layer Theis solution to represent the production zone of the Wind River Aquifer in the GHPA showed that during a simulated groundwater sweep with each of the 5 mine units pumping at 27 gpm for 3 years with no offsetting reinjection of water, drawdown greater than 2 feet would not extend beyond the boundaries of the GHPA, as shown in **Figure 4.15-4.** The production zone was modeled as a homogenous layer with an average thickness of 100 feet and an average horizontal hydraulic conductivity of 2 feet per day based

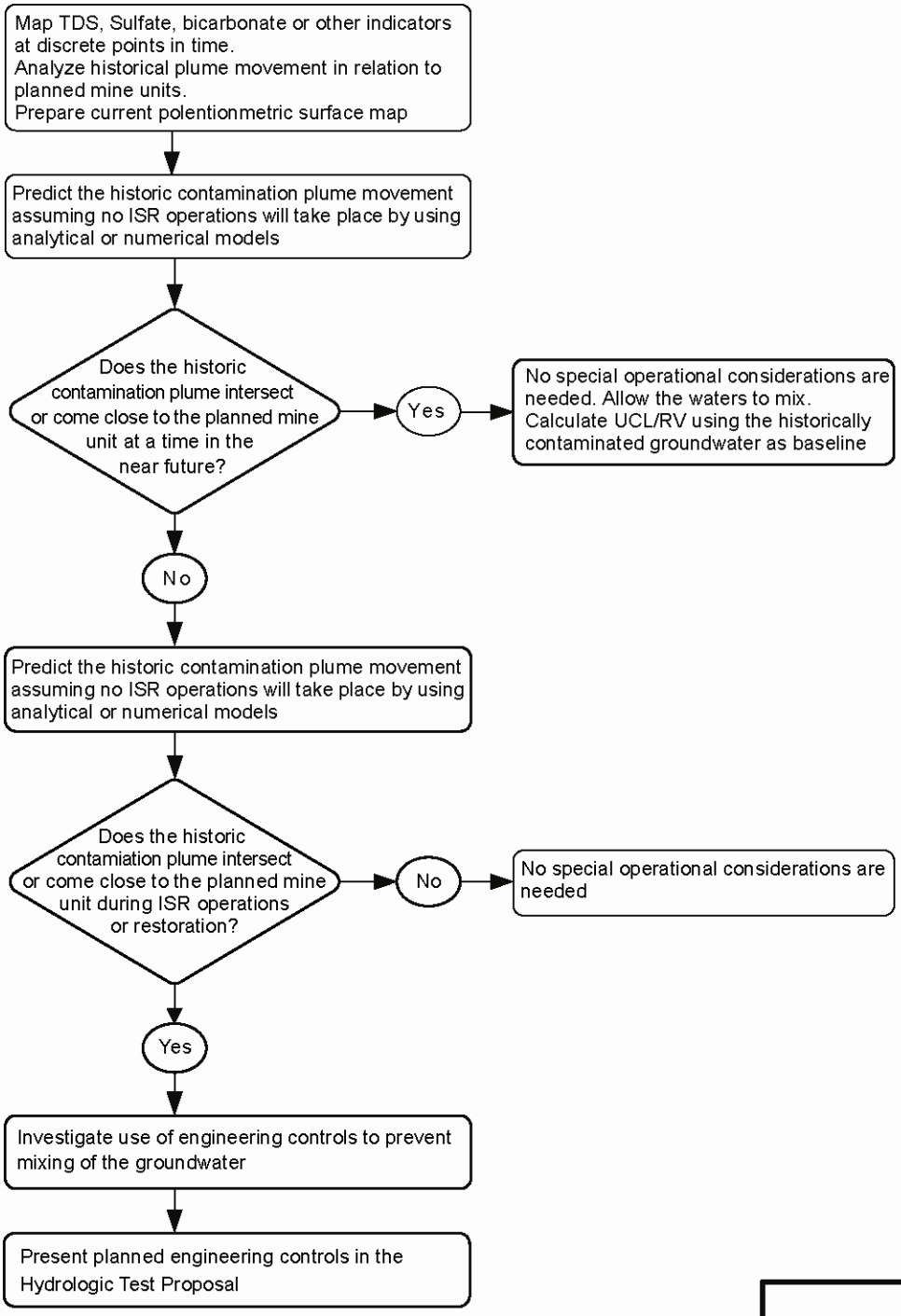


Gas Hills Project PDEIS

Figure 4.15-2

Fault Assessment

Source: PRI 2009, Figure OP5-4.



Source: Cameco 2009, Figure OP5-5.

Gas Hills Project

Figure 4.15-3

Historically Contaminated Groundwater Movement Assessment

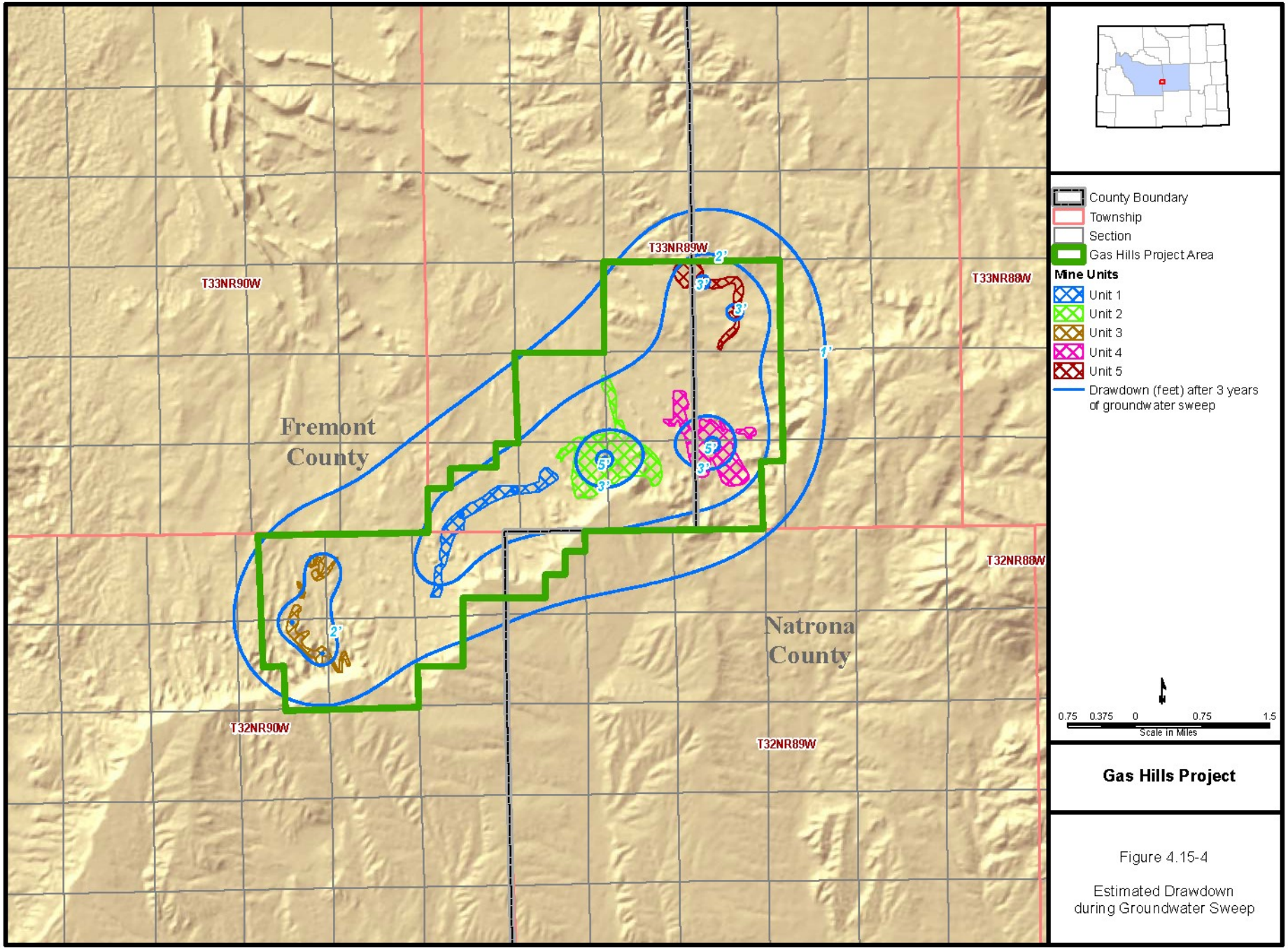


Figure 4.15-4

Estimated Drawdown during Groundwater Sweep

on pumping test results. A specific storage of 5 x 10^{-6} per foot was selected as representative of porous media under confined conditions (Fetter 1980). Initial water levels were established to roughly match the observed water levels presented in **Figure 3.15-3** and **Figure 3.15-4**. Uniform recharge of 0.125 inches per year was applied to simulate recharge from precipitation and runoff. The pumping rate of 27 gpm was based on reported rates for the Irigaray Mine (NRC 2008) and the 3-year pumping rate was based on Cameco's Smith Ranch-Highland Uranium Project in Wyoming (NRC 2008).

While this simplistic analysis indicates that drawdown impacts are not likely to extend beyond the permit boundary and minimal impacts are anticipated beyond mine units, actual drawdown impacts may differ (either more or less than predicted due to uncertainties in the conservative analysis). Prior to initiating operations, Cameco would be required by the WDEQ-LQD to conduct additional hydrologic testing and analysis (see Section 2.3.2.2) which would provide more insight into potential drawdown impacts. Cameco also would be required to submit a site-specific monitoring plan for aquifer restoration activities for approval by the WDEQ-LQD. Cameco's current plans indicate that water levels would be measured in all monitoring wells at least twice a month during operations (see Section 2.3.3.2).

Impacts from Deep Disposal of Wastewater

The Proposed Action also would involve the deep disposal of waste water as part of the Project's water management activities. Cameco is currently investigating the feasibility of deep disposal into the Cloverly, Morrison, Nugget, Phosphoria, Tensleep, Madison, or Flathead formations through the placement of up to 3 test wells in the GHPA. Test well drilling started in 2011, and test results are anticipated in 2012, but are not currently available. Deep well disposal of waste water would be conducted in accordance with the requirements of an approved Underground Injection Control (UIC) Program permit from the WDEQ-WQD for a Class I disposal well.

Permit requirements would be established to protect Underground Sources of Drinking Water (USDW) defined as groundwater with TDS concentrations less than 10,000 mg/L) in the vicinity of the disposal well. This is accomplished by the requirement that the well inject into a formation located below the lowermost USDW in the vicinity of the well and that the geological conditions, including an overlying confining zone, are sufficient to prevent migration of injected fluid into a USDW. Other permit requirements include issuing public notice, providing for public comment on draft permits, as well as holding public hearings upon request. The permit also requires monitoring of groundwater conditions to establish baseline data and to ensure the collection of information on the migration and behavior of injected fluids. In the event that a formation containing groundwater with TDS concentrations greater than 10,000 mg/l is not present beneath the GHPA, Cameco may apply for an aquifer exemption from the USEPA through the WDEQ-WQD UIC program. An aquifer exemption would be approved if Cameco can demonstrate that the aquifer cannot feasibly be developed as a source of drinking water. Assuming compliance with the UIC regulatory program requirements, impacts to groundwater from deep disposal of wastewater would not be anticipated for the Proposed Action other than a local increase in groundwater storage and formation water pressure within the formation used for disposal.

Mitigation

The following mitigation measures would be applied to further avoid, minimize, or mitigate Project-related impacts to groundwater:

GWR-1: The BLM would require Cameco to develop a drawdown level as part of their site-specific monitoring plans to be approved by the WDEQ-LQD below which additional monitoring would be conducted at increasing distances from mine units in order to determine whether drawdown impacts extend to existing water rights holders outside of the GHPA. In the event that drawdown impacts impair the ability of water rights holders to produce water, Cameco would mitigate any impact by lowering the pump in the well, deepening the well, installing a new well to a deep aquifer, modifying ISR operations, or terminating groundwater sweep activities.

Mitigation measure GWR-1 is designed to reduce or eliminate impacts to groundwater levels in the region surrounding the GHPA. Therefore, significant impacts from groundwater drawdown would not be anticipated.

Residual Impacts

Because groundwater levels would be expected to rebound after cessation of groundwater pumping during groundwater restoration, impacts would not be anticipated.

4.15.2.3 Resource Protection Alternative

Under this alternative ISR activities would be implemented within the 5 mine units in the GHPA using the same processes and water volumes to remove uranium from the same target ore zones as the Proposed Action. Therefore, impacts to groundwater quantity and quality would be the same as those discussed under the Proposed Action.

Mitigation

No additional mitigation measures would be required

Residual Impacts

No additional residual impacts would be anticipated.

4.15.2.4 Irreversible and Irretrievable Commitment of Resources

Under the Proposed Action, groundwater would be removed from the Wind River Formation in the Gas Hills District. Most of this water would be recycled as part of the ISR process. However, during the life of the Project there would be an irretrievable loss of groundwater as wastewater that would be disposed of either in evaporation ponds or through disposal of wastewater by injection to deep formations. This water loss was estimated by Cameco (PRI 2009) to be approximately 1 percent of the total amount of water pumped and recycled during the life of the Project. This would amount to approximately 6,000 acre-feet of water over the life of the Project. However, this loss would not be irreversible; lowered groundwater level as a result of mining eventually would rebound through natural recharge to the Wind River Aquifer. Additionally, the WDEQ-LQD guidelines for groundwater restoration require that pre-mining groundwater flow patterns be restored prior to mine closure.

4.15.2.5 Relationship between Local Short-term Uses and Long-term Productivity

Because the WDEQ guidelines require restoration of groundwater flow patterns (groundwater quantity) and groundwater quality to pre-mining conditions, there would be no long-term impact to groundwater productivity in the area of the Gas Hills District affected by the Project. During mining, groundwater in the mine units would not be available for domestic or agricultural use.

4.15.3 Water Use

This section describes potential impacts to current water use in the GHPA that could result from the Project. Potential issues associated with groundwater resources were identified through consultation with the BLM and cooperating agencies, or through comments provided during the scoping process, and include impacts to water supply and groundwater quality from the proposed ISR mining.

Potential impacts to water use within the GHPA were identified by reviewing locations of existing water rights (WSEO 2012), reviewing available geology and hydrogeology from state and federal agencies and Cameco (PRI 2009), and determining potential impacts to holders of water rights other than Cameco.

4.15.3.1 No Action Alternative

Under the No Action Alternative, in-situ uranium mining activities would not take place within the GHPA, and there would be no change to currently authorized water use within the GHPA.

4.15.3.2 Proposed Action Alternative

Current water rights within or immediately adjacent to the GHPA that are not held by the proponent include the Veca Pond Reservoir, Beaver Rim #2 well, C-18 Pit well, and the Cameron Springs #1 (**Table 3.15-6**). The Veca Pond Reservoir is likely not used for its use of permitted stock water, but rather is used only for WSEO acknowledgement of the waterbody left over from past mining. The Beaver Rim #2 well is located approximately 0.5 mile from the nearest mine unit (Mine Unit 5). This distance would be outside the influence of mining operations, and groundwater monitoring during Project operation would evaluate any migration of contaminated groundwater outside the mine unit area. The C-18 Pit well is a dewatering well, and because there is no consumptive use associated with this well, no impacts would occur from the Project. The Cameron Springs #1 is a reservoir supplied by Cameron Springs, which is a perched aquifer upgradient of the Project in the Wagon Bed Formation, and would not be affected by the Project.

Current water rights outside the GHPA, but within the area of potential groundwater impacts are shown in **Figure 3.15-5** and summarized in **Table 3.15-6**. There would be no impact to water quality in any of these wells during mine operations or during post-mining groundwater restoration. Potential short-term impacts to water quantity from drawdown during groundwater restoration are addressed in Section 4.15.2.2.

<u>Mitigation</u>

Because anticipated impacts to water use within the GHPA would not be significant, no additional mitigation measures to avoid, minimize, or mitigate impacts would be required. Potential impacts to water quantity in the area surrounding the GHPA would not be significant by implementation of mitigation measure GWR-1.

<u>Residual Impacts</u>

No significant long-term impacts would be anticipated to water availability or use due to the Project, and therefore, residual impacts also would not be anticipated.

4.15.3.3 Resource Protection Alternative

Potential impacts to water use associated with the RPA would be the same as for the Proposed Action Alternative.

<u>Mitigation</u>

No additional mitigation measures would be required.

<u>Residual Impacts</u>

No residual impacts would be anticipated.

4.15.3.4 Irreversible and Irretrievable Commitment of Resources

Irreversible impacts to water use are not anticipated since properly implemented ACMs and BMPs, including reclamation, would reduce effects on water quantity and quality over time. Under the Proposed Action, consumptive use of groundwater from the Project's proposed in-situ mining process is estimated to be approximately 6,000 acre-feet of water (PRI 2009) over the life of the Project. This would represent irretrievable commitment of water; however, this loss would not be irreversible as this groundwater would eventually be replaced by recharge to the Wind River Formation

4.15.3.5 Relationship between Local Short-term Uses and Long-term Productivity

Properly implemented monitoring and groundwater restoration would reduce or eliminate potential impacts to water rights holders not held by the proponent; therefore, no impacts to long-term productivity would be anticipated.

4.16 Wild Horses

The primary issues associated with wild horses and wild horse HMAs were identified by the BLM through internal scoping, consultation with cooperating agencies, and through comments provided during the scoping process. Issues include direct and indirect impacts that reduce forage, negatively impact water sources and rangeland improvements, and impairment of the wild and free roaming characteristics of wild horse behavior within HMAs. The methodology for assessing impacts to wild horses and HMAs is based on impact parameters that are used as indicators for quantifying impacts between alternatives. The overlap of surface disturbances and HMAs was used to determine loss of acreage and appropriate management levels.

The following assumptions were used in the analysis of impacts to wild horses and HMAs:

- Current HMA appropriate management levels reflect the desired population for the present and foreseeable future of the affected HMAs; and
- An increase vehicular traffic would contribute to difficulties in management of wild horses and HMAs.

4.16.1 No Action Alternative

Under the No Action Alternative, the Project would not be approved. Current land use and surface-disturbing activities would continue as currently authorized. Under this alternative the Carol Shop facility, 1 road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres, resulting in an increase in forage. Exploratory drilling would continue at the rate of approximately 5 acres per year.

4.16.2 Proposed Action Alternative

Under the Proposed Action there would be no direct impacts to wild horses or HMAs. As described in Section 3.17.1, Terrestrial Wildlife, the Muskrat Basin lies 5 miles to the southwest of the GHPA and the Conant Creek, Rock Creek, and Dishpan Butte HMAs are west of Muskrat Basin; therefore, the GHPA does not intersect this group of HMAs, known collectively as the North Lander Complex of HMAs. There would be potential for construction and maintenance vehicles to encounter wild horses outside of the GHPA on CR 5 between Jeffrey City and the GHPA, and indirect impacts would consist of infrequent animal/vehicle collisions involving wild horses that wander the unfenced CR 5 within the Muskrat Basin HMA.

<u>Mitigation</u>

WHS-1: Signage would be posted in the GHPA to notify Project personnel that wild horses may be encountered along the road.

Implementation of WHS-1 would mitigate impacts to wild horses due to vehicle collisions.

<u>Residual Impacts</u>

No significant impacts would be anticipated to wild horses from the Project, and therefore, residual impacts also would not be anticipated.

4.16.3 Resource Protection Alternative

Under the RPA, modifications would be implemented to reduce the environmental impacts of the Project. Modifications include closed-loop drilling and slurry transportation, which are described in detail in Section 2.4, Resource Protection Alternative. Impacts to wild horses under the RPA would be the same

as described above for the Proposed Action Alternative. No additional direct or indirect impacts would be anticipated.

Mitigation

No additional mitigation measures would be required.

Residual Impacts

No residual impacts would be anticipated.

4.16.4 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible or irretrievable commitment of resources during the lifetime of the Project for all Action Alternatives due to a lack of overlap between the GHPA and the North Lander Complex of HMAs. There would be no loss of forage and no reduction in appropriate management levels would be required.

4.16.5 Relationship between Local Short-term Uses and Long-term Productivity

Short-term uses associated with the Project would not affect the long-term productivity of the HMAs and their resident herds.

4.17 Wildlife and Fisheries

The impact assessment analysis area for wildlife and fisheries resources includes all wildlife habitats located within the GHPA. This includes construction and operation of all 5 mine units, associated access roads, power lines, water management components, and other mine-related ancillary facilities.

Wildlife- and fisheries-related issues addressed by this impact assessment were determined by the BLM through internal scoping, consultation with cooperating agencies and the USFWS, and through comments provided during the scoping process. Relevant scoping issues related to wildlife, fisheries, and special status wildlife species include loss or alteration of native and reclaimed habitats, increased habitat fragmentation, animal displacement, direct loss of wildlife, introduction and expansion of noxious and invasive weed species, and impacts associated with wildlife exposure to waste water (i.e., evaporation ponds).

Potential impacts to wildlife and fisheries resources within the GHPA were identified by reviewing existing data sources and literature, quantifying the extent to which the Project could impact habitat, individuals, or populations, and identifying any conflicts with applicable land use plans and/or regulations.

As discussed in Section 3.17, Wildlife and Fisheries, fisheries do not exist within the GHPA, and are not further discussed in this section. The analysis for wildlife resources assumed the following:

- The BLM would continue to manage wildlife and fish habitats in coordination with the WGFD;
- The USFWS would have jurisdiction over the management of any affected federally listed threatened, endangered, or proposed wildlife species, as well as migratory birds; and
- The BLM manages the habitat in consideration of the species listed in BLM Wyoming State Director's Sensitive Species List in accordance with BLM Manual 6840.

4.17.1 No Action Alternative

Under the No Action Alternative, the Project would not be approved and management of the GHPA would continue under current authorizations and land uses.

Under this alternative the Carol Shop facility, 1 road, and previously disturbed land would be reclaimed, resulting in the reclamation of approximately 40 acres. New disturbance to wildlife habitat associated with continued exploration activities would continue within the GHPA at a rate of 5 acres or less each year. This disturbance would occur primarily in mixed sagebrush-grassland and rough breaks habitat types. Reclamation of these sites to wildlife habitat would be anticipated to occur within the same calendar year as the disturbance, and vegetation would require a minimum of 3 to 5 years to be fully reestablished. These activities would have little impact on wildlife populations within the GHPA. Reseeding sites disturbed for reclamation likely would occur within 12 months of the disturbance activity. If reclamation practices are successful, wildlife likely would return to the site after a period of 3 to 5 years (short-term impacts) but depending on the target vegetation community of the disturbance site (e.g., sagebrush) it may take more than 20 years to return to pre-disturbance conditions (long-term impacts).

4.17.2 Proposed Action Alternative

Impacts to wildlife resources under the Proposed Action would include surface disturbance or alteration of native and reclaimed habitats, increased habitat fragmentation, animal displacement, changes in plant species composition, and direct loss of wildlife. The severity of these impacts on terrestrial wildlife species would depend on factors such as the sensitivity of the species, current population trends, seasonal use patterns, type and timing of Project activity, and physical parameters (e.g., topography, cover, forage, climate).

Habitat loss can be defined as short-term and long-term impacts. Short-term impacts would arise from habitat removal and disturbance during construction. The timeframe for short-term impacts is usually 1 to 5 years. Long-term impacts consist of changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success. The timeframe for long-term impacts is usually greater than 5 years. Activities associated with operation would be long-term, and would cease upon mine unit completion and successful reclamation. Disturbance to wildlife during the critical breeding and birthing periods that result in the loss or abandonment of eggs or young can have both short-term and long-term impacts to the species population.

Habitat impacts can be categorized as direct and indirect. Direct habitat impacts result when habitat is destroyed or converted to a form that is unsuitable for the resident species. The primary potential indirect impact would be wildlife avoidance (displacement) of otherwise suitable habitat in and around the GHPA.

4.17.2.1 Terrestrial Wildlife

Big Game Species

Potential direct impacts to big game species (e.g., mule deer, pronghorn, and elk) from development activities on undisturbed lands (**Table 4.13-1**) include 1,206 acres of short-term and 572 acres of long-term surface disturbance to habitat within the GHPA. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. As stated in Section 3.17, Wildlife and Fisheries, no designated big game crucial winter range occurs within the GHPA. A variety of other types of big game habitat (i.e., spring/summer/fall, yearlong, winter/yearlong) are present within the GHPA. However, these habitat types are not considered limiting in Wyoming by the WGFD.

Pronghorn are the most abundant big game species within the GHPA; therefore, direct impacts to pronghorn would be more pronounced than direct impacts to mule deer and elk. The loss of available woody/shrubby vegetation from any disturbance in that vegetation community would be long-term (up to 20 years). However, herbaceous species could become established within 3 to 5 years, depending on reclamation success and weather conditions (i.e., precipitation). In most instances, suitable habitat adjacent to the GHPA would be available for big game species until grasses and woody vegetation were re-established within the disturbance areas.

Additional impacts to big game species would result from increases in noise levels and human presence during construction and operation. Displacement of big game as a result of direct habitat loss and indirect reduction in habitat quality has been widely documented (Irwin and Peek 1983; Lyon 1983, 1979; Rost and Bailey 1979; Ward 1976). Studies have shown that big game species tend to move away from areas of human activity and roads, thereby reducing habitat utilization near disturbance areas (Cole et al. 1997; Sawyer et al. 2006; Ward 1976). Mule deer and pronghorn appear to be more tolerant of human activity than elk. For mule deer, displacement distances ranged from 330 feet to 0.6 mile, depending on the presence of vegetative cover (Ward 1976). For evaluation purposes, 660 feet was the most common displacement distance used for mule deer, especially in areas with minimal vegetative cover. For analysis of the Project, this distance also would apply to pronghorn. Mule deer and pronghorn have been observed to habituate to vehicles, and displacement distances decreased when traffic was predictable, moving at constant speeds, and was not associated with out-of-vehicle activities (Ward 1976). However, traffic within the GHPA would be characterized by slow moving traffic, vehicles that stop, and out of vehicle activity; thus, acclimation by big game would not be anticipated. The potential for big game mortalities from Project-related vehicles along the access roads would be reduced by Project-regulated speed limits on access roads to and within the GHPA.

Impacts to black bears and mountain lions would be low, as these species occur at low densities in this region of Wyoming and no important habitat occurs in or around the GHPA.

Based on the amount of suitable habitat surrounding the GHPA, and the lack of crucial winter range (considered to be the limiting factor for big game populations by WGFD) within or immediately adjacent

to the GHPA, impacts to big game species would be minor and localized to the GHPA and would be limited primarily to displacement from areas of human activity and habitat alteration.

Small Game Species

Direct and indirect impacts to small game would include: wildlife mortalities or displacement related to construction and operation; habitat loss, alteration and fragmentation; exposure to potentially toxic waste water; and increased levels of noise, activity, and human presence. Project construction and operation on undisturbed lands (**Table 4.13-1**) would result in the short-term loss of 1,206 acres and long-term loss of 572 acres of potential habitat, until completion of reclamation and re-establishment of vegetation. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. However, in most instances, suitable habitat adjacent to the GHPA would be available for small game species until grasses and woody vegetation were re-established within the disturbance areas. Fragmentation impacts on some small game species have been shown to negatively impact populations. Small game, especially upland game birds, could experience increased mortality rates due to increased access as a result of new and improved roads (Holbrook and Vaughan 1985). Vehicular traffic could injure or kill individuals, and local populations could experience higher levels of hunting and poaching pressure due to improved access (Holbrook and Vaughan 1985). These temporary losses would reduce productivity during each breeding season affected. The greater sage-grouse is classified as a federal candidate species as well as a BLM sensitive species and, therefore, is discussed further in Section 4.17.2.4, Special Status Wildlife Species.

Specific impacts to waterfowl would include the short-term loss of 15 acres and long-term loss of 8 acres of wetland habitat within the surface disturbance areas (i.e., Mine Unit 4). This would account for approximately 17 percent and 9 percent of the existing waterfowl habitat within the GHPA. In addition to habitat loss, waterfowl also could be impacted by exposure to waste water in the evaporation ponds. If exposure to wastewater in the evaporation ponds results in waterfowl mortalities due to toxicity, impacts could be significant. Given the small amount of suitable waterfowl habitat within the GHPA (approximately 86 acres) and surrounding region, impacts to waterfowl as a result of the Project may be more pronounced than for other small game species.

Nongame Species

Direct and indirect impacts to nongame species would include: wildlife mortalities or displacement related to construction and operation; habitat loss, alteration, and fragmentation; exposure to potentially toxic waste water in evaporation ponds; and increased levels of noise, activity and human presence. Project construction and operation on previously undisturbed lands (**Table 4.13-1**) would result in the short-term loss of 1,206 acres and long-term loss of 572 acres of potential habitat, until reclamation was completed and vegetation re-established. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. Construction activities could result in mortalities of less mobile or burrowing nongame species (e.g., small mammals and reptiles) within ROWs or mine units, as a result of crushing from construction vehicles and drilling equipment. Impacts also could include temporary displacement of more mobile species (medium sized mammals and adult birds) from areas with surface disturbance, due to the short-term and long-term loss of vegetation. The temporary displacement of some species would continue until herbaceous vegetation was returned to pre-construction conditions (approximately 3 to 5 years). For those species dependent on the sagebrush-steppe habitat, displacement would occur until sagebrush shrubs become re-established (up to 20 years).

4.17.2.2 Raptors and Other Migratory Birds

A number of raptor species (e.g., golden eagle, ferruginous hawk, prairie falcon, red-tailed hawk, Swainson's hawk, and great-horned owl) seasonally occupy habitats found within the GHPA. Potential direct impacts to raptors would result from the short-term and long-term disturbance of approximately 1,206 acres and 572 acres of potential habitat, respectively. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. Impacts to raptor species can result from the loss or alteration in habitat, reduction in prey base, and increased human disturbance. The loss

of native habitat to human development has resulted in declines of hawks and eagles throughout the West (Boeker and Ray 1971; Schmutz 1984). In some cases, habitat changes have not reduced numbers of raptors but have resulted in shifts in species composition, such as a reduction in nesting ferruginous hawks and Swainson's hawks and an increase in nesting golden eagles and red-tailed hawks (Harlow and Bloom 1987). Impacts to small mammal populations due to habitat loss and fragmentation can result in a reduced prey base for raptors, resulting in lower raptor densities. Thompson et al. (1982) and Woffinden and Murphy (1989) found that golden eagles and ferruginous hawks had lowered nesting success where native vegetation had been lost and was unable to support jackrabbit (prey) populations. Furthermore, raptors have a high potential of being disturbed from nests and roosts, thereby leading to displacement and reduced nesting success (Holmes et al. 1993; Postovit and Postovit 1987; Stalmaster and Newman 1978).

Breeding raptors in or adjacent to the GHPA could abandon breeding territories, nest sites, or lose eggs or young as a result of Project construction and operation activities that occur during the raptor breeding season (February 1 to July 31). Loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and, in the case of the golden eagle, would violate the Bald and Golden Eagle Protection Act. Loss of active nest sites could potentially impact populations of raptors that occur within the GHPA. Given the number of raptor nests present within the GHPA (40 documented from surveys in 2009, 2010, and 2011), it is likely that a reduction in habitat suitability and overall carrying capacity for raptors would occur if surface disturbance activities occurred within 0.5 mile of an active raptor nest (0.75 mile for ferruginous hawks). Furthermore, future nest sites and foraging habitat would be influenced by surface disturbance activities and increased human presence within the GHPA.

Other avian species that could be impacted by construction and operation activities include nesting passerines or songbirds that use the various habitats within the GHPA. Direct and indirect impacts to these avian species would include: mortalities or displacement related to construction and operation; habitat loss, alteration and fragmentation; exposure to potentially toxic waste water in evaporation ponds; and increased levels of noise, activity, and human presence. Project construction and operation would result in the short-term loss of 1,206 acres and long-term loss of 572 acres of potential habitat. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. Impacts to breeding migratory birds could result in the abandonment of a nest site or territory, or the loss of eggs or young if Project activities were to occur during the breeding season (May 15 to June 30). Similar to raptor species, loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and could potentially impact populations of important migratory birds that occur within the GHPA. In addition, loss of an active nest would not be in compliance with BLM EO 13186.

In addition to the impacts described above, reductions in bird population densities in both open grasslands and woodlands also could be attributed to a reduction in habitat quality produced by elevated noise levels (Reijnen et al. 1997, 1995). Although visual stimuli in open landscapes may add to density effects at relatively short distances, the effects of noise appear to be the most critical factor since breeding birds of open grasslands (threshold noise range of 43 to 60 dB[a]) and woodlands (threshold noise range of 36 to 58 dB(A)) respond very similarly to disturbance by traffic volume (Reijnen et al. 1997). Reijnen et al. (1996) determined a threshold effect for bird species to be 47 dB(a), while a New Mexico study in a pinyon-juniper community found that impacts of gas well compressor noise on bird populations were strongest in areas where noise levels were greater than 50 dB(a). However, moderate noise levels (40 to 50 dB[a]) also showed some effect on bird densities in this study (LaGory et al. 2001). Based on these studies for migratory birds and those described above for raptors, increased noise levels and human activity as a result of the Project could preclude otherwise acceptable migratory bird and raptor habitat from use by species found within the Project region.

As described in Section 2.3.1.5, Power Lines, approximately 21 miles of new 69-kilovolts (kV) aboveground power lines would be constructed to supply power to the header houses in each of the mine units. Surface disturbance from the power line poles would be within the road ROWs, so disturbance would not increase within wildlife habitat. Power lines would incrementally increase the

collision potential for migrating and foraging bird species. However, collision potential typically is dependent on variables such as the location in relation to high-use habitat areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns and movement corridors, species composition, visibility, and line design (APLIC 2006). To minimize potential electrocution and collision impacts to migrating and foraging migratory bird species, Cameco has committed to following APLIC (2006) guidelines (i.e., Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006) as discussed in Section 2.3.8, Applicant-committed Environmental Protection Measures. Measures outlined in this document would be effective in reducing impacts to migrating and foraging migratory bird species by requiring design features (e.g., line spacing, etc.) that limit the potential for electrocution, primarily to raptor species.

To prevent wildlife exposure to potentially toxic waste water in the evaporation ponds, Cameco has committed to installing fences around the evaporation ponds to prevent access, which would reduce the risk of exposure to terrestrial wildlife species (e.g., big game, small game, and reptiles). However, fencing may not be sufficient to reduce the risk of impacts to burrowing wildlife species and bird and bat species. Impacts to bird and bat species could occur as a result of exposure to potentially toxic waste water in the evaporation ponds. If waste water in the evaporation ponds maintains toxic levels and exposure results in bird and/or bat mortalities, impacts could be significant.

4.17.2.3 Reptiles and Amphibians

Similar to the other nongame species discussed above, impacts to reptiles and amphibians as a result of the Project would include mortalities or displacement related to construction and operation and habitat loss, alteration, and fragmentation. Construction activities could result in direct mortalities as a result of crushing of burrows from vehicles and equipment. However, due to suitable habitat adjacent to the GHPA and interim reclamation being completed concurrent with operations, impacts to reptiles and amphibians would be limited primarily to disturbed areas. Implementation of VEG-1 would eliminate any impacts to amphibians that could occur as a result of water contamination in wetlands or riparian areas.

4.17.2.4 Special Status Wildlife Species

The following impact assessments focus on special status wildlife species, which include those species federally listed as threatened, endangered, proposed, or candidate species, as well as BLM sensitive species with the potential to occur within the GHPA. These species are identified in Section 3.17.3, Special Status Wildlife Species.

<u>White-tailed Prairie Dog (BLM Sensitive)</u>

Impacts to prairie dog species could include direct mortalities of individuals, as a result of crushing from construction activities, vehicles, and equipment. Additional impacts could result from increased habitat fragmentation and human presence and noise. Based on the results of the 2009, 2010, and 2011 field surveys (HWA 2011a,b, 2009), a total of 9 white-tailed prairie dog colonies occur within the GHPA. Approximately 5.6 acres of active white-tailed prairie dog colonies would be disturbed by construction activities, and approximately 0.05 acre would be impacted during Project operation (HWA 2011a,b). This would account for approximately 37 percent of the total active white-tailed prairie dog colonies within the GHPA.

Construction activities would not be anticipated to permanently alter white-tailed prairie dog colonies within the GHPA. Habitat disturbance could actually encourage future colonization in the short-term, based on the availability of soft, permeable soils that would occur within the disturbed areas subsequent to the Project construction.

<u>Pygmy Rabbit (BLM Sensitive)</u>

Impacts to the pygmy rabbit could include direct mortalities of individuals as a result of crushing from construction activities, vehicles, and equipment. Additional impacts could result from increased habitat

fragmentation, human presence, and noise. Project construction and operation would result in the short-term loss of 93 acres and long-term loss of 42 acres of potentially suitable sagebrush habitat for this species until reclamation was completed and the mature sagebrush communities re-established. This would account for approximately 9 percent and 4 percent of existing sagebrush habitat within the GHPA. Given the extent of suitable sagebrush habitat in the surrounding region, the geographic location of the GHPA (i.e., on the periphery of the pygmy rabbit's known range), and the lack of documented occurrences during species-specific surveys (HWA 2011a,b), activities associated with the Project would not be anticipated to adversely affect the local population of this species. Therefore, impacts to the pygmy rabbit would be minor.

Bat Species (BLM Sensitive)

Two BLM sensitive bat species, the Townsend's big-eared bat and spotted bat, could be impacted by Project construction. No impacts to communal roosts (e.g., hibernacula, nursery colonies, bachelor roosts) would be anticipated from Project construction, based on review of bat literature for Wyoming and the results of surveys conducted in 2010 (HWA 2011a). Project construction and operation would result in the short-term loss of 1,206 acres and long-term loss 572 acres of potentially suitable foraging habitat for these bat species until reclamation has been completed and the plant communities have been re-established. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. Given the extent of suitable foraging and roosting habitat in the surrounding region and the lack of documented occurrences within the GHPA (HWA 2011a), activities associated with the Project would not be anticipated to adversely affect the local population of these species. Therefore, impacts to BLM sensitive bat species would be minor.

Ferruginous Hawk (BLM Sensitive)

Impacts to ferruginous hawks generally would be the same as described for raptors in Section 4.17.2.1, Terrestrial Wildlife. Impacts specific to ferruginous hawks, if present, would result in the short-term loss of 1,206 acres and long-term loss of 572 acres of potentially suitable upland habitats. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. Additional impacts such as displacement and avoidance also would result from increased noise and human presence associated with construction activities. Based on the results of the 2009, 2010, and 2011 breeding raptor surveys, one active nest is located northwest of the GHPA but its protection buffer does not overlap with the GHPA. Therefore, impacts to ferruginous hawks would be limited primarily to foraging habitat.

Burrowing Owl (BLM Sensitive)

Impacts to burrowing owls generally would be the same as described for raptors in Section 4.17.2.1, Terrestrial Wildlife. Impacts specific to burrowing owls, if present, would result from the short-term loss of 834 acres and 396 acres of long-term loss of potential habitat within the GHPA. This would account for approximately 17 percent and 8 percent of the existing habitat within the GHPA. Additional impacts such as displacement and avoidance also would result from increased noise and human presence associated with construction and operation activities. However, due to the lack of occurrences of this species within the GHPA in recent years, impacts would be low.

Greater Sage-grouse (Federal Candidate, BLM Sensitive)

Impacts to greater sage-grouse would result in the short- to long-term (depending on the ecological site characteristics) loss of potentially suitable breeding, brood rearing, and nesting habitats (**Table 4.17-1**). Impacts to greater sage-grouse would include increased habitat fragmentation as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic. An increase in noxious and invasive weeds reduces habitat quality by eliminating important native species of plants that provide both cover and food for greater sage-grouse. Project-related impacts also could lead to increased vehicle collision potential as well as increased predation by raptors, corvids, and coyotes as a result of decreased sagebrush vegetation cover associated with surface disturbing activities.

Table 4.17-1 Greater Sage-grouse Habitat Potentially Impacted by the Project under the Proposed Action

BLM FO	Lek Buffer/Habitat Type[a]	Existing Habitat (acres)	Estimated Surface Disturbance (acres)[b]	
			Short-term	Long-term
Lander	0.6 Mile No Surface Occupancy (NSO) (Core Area[c])	0	0	0
	0.25 Mile NSO (Non-core Area)	0	0	0
	Nesting Habitat (Core Area[c])	12	0	0
	Nesting Habitat (Non-core Area – 2 mile-buffer of an occupied lek)	2,119	421.6 (20 percent)	37.9 (2 percent)
Casper	0.6 Mile NSO (Core Area[c])	0	0	0
	0.25 Mile NSO (Non-core Area)	0	0	0
	Nesting Habitat (Core Area[c])	0	0	0
	Nesting Habitat (Non-core Area – 2-mile buffer of an occupied lek)	0	0	0
Total		**2,119**	**421.6 (20 percent)**	**37.9 (2 percent)**

[a] Lek buffers based on (BLM IM 2010-012), Wyoming EO 2011-5, and BLM (2007).

[b] Includes disturbance associated with the mine units and Project infrastructure.

[c] Core areas are designated by the WGFD and are managed according to Wyoming EO 2011-5.

As presented in **Table 4.17-1**, no Project-related surface disturbance would occur within areas with greater sage-grouse lek NSO restrictions. In addition, no impacts to the Greater South Pass Core Area would occur as the 12 acres of core area within the GHPA is located in the extreme southern portion of the GHPA. Impacts to greater sage-grouse nesting habitat would occur entirely within the BLM Lander FO and consist of the disturbance of the short-term loss of 421.6 acres (20 percent) and the long-term loss of 37.9 acres (2 percent) of potentially suitable habitat.

Recent studies on greater sage-grouse have shown that energy development can negatively impact populations as a result of increased noise and increased human disturbance (Holloran 2005; Walker et al. 2007). Greater sage-grouse have been observed to abandon lek sites in areas with increased road development (Holloran 2005; Braun 1986; Walker et al. 2007). Brooding female greater sage-grouse in Canada were shown to avoid areas with increased density of visible oil wells. Chick survival decreased as oil well densities within 0.6 mile (1 km) of brooding locations increased (Aldridge 2005). In western Wyoming, brooding female greater sage-grouse avoided producing gas wells during the early brood-rearing period (Holloran 2005).Compared to hens near undisturbed leks, greater sage-grouse hens that used leks within approximately 2 miles of oil and gas development moved further away from leks to nesting areas and had lower nest initiation rates (Lyon and Anderson 2003). Connelly et al. (2000) recommend that energy-related facilities be located more than 2 miles (3.2 km) from active lek sites under ideal habitat conditions, 3 miles (5 km) when habitat conditions are not ideal, and 11 miles (18 km) when sage-grouse populations are migratory. Furthermore, greater sage-grouse hens

that utilized nesting habitats further from roads had greater brood survivorship than those hens utilizing habitat near roads (Lyon and Anderson 2003).

Recent research in Wyoming has shown that greater sage-grouse also may be negatively influenced within or near winter habitats by coal-bed natural gas (CBNG) development. Doherty et al. (2008) found that hens avoided wintering areas with CBNG development, and were 30 percent less likely to use an area with CBNG development even if it contained suitable habitat. Research also has shown that, as a result of increased food sources associated within oil and gas developments (e.g., road kill, litter, etc.), population levels of predators, especially corvids, generally increases over time unless deterrents are used on energy field-related structures (Andren 1992; Avery and Genchi 2004). Wildlife surveys conducted within the GHPA over the past 3 years have documented greater sage-grouse during the spring and summer, including hens with their broods. Therefore, impacts from the Project to greater sage-grouse may occur and would be more pronounced if disturbance occurs during the breeding season (March 1 to July 15). In addition to increased habitat disturbance and fragmentation impacts, the new power lines constructed within the GHPA to each mine unit would increase the potential for collisions and also would provide additional perches for predators (i.e., raptors and corvids). Approximately 7.2 miles of 69-kV power lines would be constructed within 2 miles of the WCC lek.

West Nile virus (WNv) also may be a concern for the Project due to the presence of drilling mud pits during construction and evaporation ponds during operation, with the possibility of increased mosquito populations in the GHPA. WNv is a mosquito-borne disease that can cause a brain infection, encephalitis, that leads to mortality in greater sage-grouse. Mosquitoes spread this virus after they feed on infected birds and then bite non-infected birds. Since its discovery in 1999 in New York, WNv has become firmly established and spread across the U.S. Birds are the natural vector host and serve not only to amplify the virus, but to spread it. Although less than 1 percent of mosquitoes are infected with WNv, they still are very effective in transmitting the virus to greater sage-grouse in areas with high mosquito populations. Although most of the attention has been focused on human health issues, WNv has had an impact on vertebrate wildlife populations, including greater sage-grouse. The Wyoming State Vet Lab determined 22 greater sage-grouse in 1 study project (90 percent of the study birds), succumbed to WNv in the Powder River Basin (PRB) in 2003. While birds infected with WNv have many of the same symptoms as infected humans, they appear to be more sensitive to the virus. Mosquitoes can potentially breed in any standing water that lasts more than 4 days. In the GHPA, the Project generally would result in increased surface water availability associated with Project development. This increase in potential mosquito breeding habitat provides opportunities for mosquito populations to increase. Preliminary research conducted in the PRB of Wyoming indicates WNv mosquito vectors were notably more abundant on a developed CBNG site than 2 similar undeveloped sites (Walker 2008). Reducing the population of mosquitoes, especially species that are apparently involved with bird-to-bird transmission of WNv, such as *Culex tarsalis*, can help to reduce or eliminate the presence of the virus (Animal and Plant Health Inspection Service [APHIS] 2012) in the GHPA and immediate vicinity.

Due to the historic mining disturbance and partially reclaimed wildlife habitat, the GHPA contains a limited amount of tall, mature sagebrush on south- and east-facing slopes that typically is required for greater sage-grouse winter habitat (Section 3.17.2.2, Birds). In addition, no greater sage-grouse winter concentration areas have been identified within the GHPA. Although greater sage-grouse may use portions of the GHPA during the winter months, it is likely that higher quality winter habitat south and west of the GHPA supports the majority of wintering greater sage-grouse in the Project region; therefore, impacts to wintering greater sage-grouse from the Project would be minor.

<u>Brewer's Sparrow, Loggerhead Shrike, Sage Sparrow, and Sage Thrasher (BLM Sensitive)</u>

Impacts to Brewer's sparrow, loggerhead shrike, sage sparrow, and sage thrasher generally would be the same as described for migratory birds in Section 4.17.2.1, Terrestrial Wildlife. Impacts specific to these 4 species, if present, would occur as a result of the short-term loss of 1,206 acres and the long-term loss of 572 acres of potentially suitable upland habitats within the GHPA. This would account for approximately 15 percent and 7 percent of the existing habitat within the GHPA. Additional impacts

such as displacement and avoidance also would result from increased noise and human presence associated with construction and operation activities. However, due to the amount of suitable habitat in the Project vicinity, impacts would be minor.

Mountain Plover (BLM Sensitive)

Due to the documented presence of this species within the GHPA in 2009 and 2010, impacts to mountain plovers would occur as a result of the short-term loss of 1.3 acres (<1 percent) and long-term loss of 0.1 acres (<1 percent) of potentially suitable nesting habitat. In addition, seed from reclaimed areas adjacent to the mountain plover habitat may disperse onto suitable mountain plover habitat which would increase vegetation cover and reduce habitat quality.

Additional impacts such as displacement and avoidance also would result from increased noise and human presence associated with construction and operation activities. If construction and operation activities occur during the mountain plover breeding season (April 10 to July 10) and surface-disturbance activities resulted in the loss of an active nest, impacts to the mountain plover could be significant.

Northern Leopard Frog and Great Basin Spadefoot (BLM Sensitive)

Potential impacts to special status aquatic species, including the northern leopard frog and Great Basin spadefoot, could include direct mortalities of individuals from construction activities, ground compaction, and vehicle traffic within suitable habitat. Impacts also could result from the short-term loss of 15 acres and 8 acres of long-term loss of potentially suitable habitat until reclamation was completed and vegetation re-established. This would account for approximately 21 percent and 11 percent of the existing habitat within the GHPA. Implementation of VEG-1 would eliminate any impacts to these 2 species that may occur as a result of water contamination in wetlands or riparian areas. Therefore, the Project could impact individuals but would not likely cause a trend towards federal listing or loss of viability.

Mitigation

The following mitigation measures would be applied to further avoid, minimize, or mitigate Project-related impacts to wildlife and special status wildlife species.

WFM-1: To protect breeding migratory bird species and greater sage-grouse, surface disturbing activities would be restricted on currently undisturbed lands within the GHPA between May 15 and June 30 for nesting migratory birds and between March 1 and July 15 within 2 miles of an occupied lek for lekking, nesting, and brooding greater sage-grouse. Should removal of habitat be required between these dates, Cameco would coordinate with the BLM and USFWS to conduct breeding migratory bird and greater sage-grouse surveys and implement appropriate mitigation, such as buffer zones around occupied nests, as needed.

WFM-2: To protect breeding raptor species, Cameco would avoid all existing raptor nest sites and surface disturbing activities during the breeding season (February 1 to July 31) within applicable nest protection buffers (i.e., 0.75 mile, unless site-specific, species-specific distances are determined and approved by the BLM). If construction were to extend into the raptor breeding season, Cameco would conduct aerial and/or pedestrian nesting raptor surveys, as applicable, through areas of suitable habitat to identify active nest sites within the GHPA, prior to construction. Since a number of variables (e.g., nest location, species' sensitivity, breeding, phenology, topographical shielding) would determine the level of impact to a breeding pair, appropriate protection measures, such as seasonal constraints and establishment of buffer areas, would be implemented at active nest sites on a species-specific and site-specific basis, in coordination with the jurisdictional agencies (e.g., BLM or USFWS).

WFM-3: To protect bat species and migratory bird species, including raptors and waterfowl, Cameco would install bird exclusion netting over evaporation ponds containing waste water in order to eliminate migratory bird and bat exposure to potentially toxic waste water.

WFM-4: To reduce potential collision impacts to migratory bird species, power lines in areas identified as having high bird use (e.g., wetlands) would be fitted with high visibility markers. In addition, to prevent electrocution to raptor species, power lines in high raptor use areas (e.g., within 0.75 of a nest site and within 0.25 mile of a white-tailed prairie dog colony) would be fitted with anti-perching devices.

SSS-1: To protect breeding burrowing owls, surveys for burrowing owl nests would be conducted during the breeding season (April 15 to September 15) prior to surface disturbing activities in areas of potentially suitable habitat (i.e., white-tailed prairie dog colonies). If a nest is located, a 0.25 mile protection buffer would be implemented around the active nest until the birds fledge from the nest.

SSS-2: To limit raptor and corvid predation on greater sage-grouse, new power lines within 2 miles of occupied greater sage-grouse leks (e.g., West Canyon lek) would be fitted with anti-perching devices (e.g., spikes, triangles, inverted “Y’s”, etc.).

SSS-3: To protect nesting mountain plovers, nest surveys would be conducted if construction were to occur during the breeding season (April 10 to July 10). If a nest is located, a 0.25 mile protection buffer would be implemented around the active nest until the birds fledge from the nest.

Mitigation measure WFM-1 is designed to minimize impacts to bird species protected under the MBTA and greater sage-grouse by avoiding construction during the breeding season. According to the Wyoming PIF Bird Conservation Plan (Nicholoff 2003), the primary dates for most breeding grassland/shrubland bird species in Wyoming are May 15 to June 30. For greater sage-grouse, the primary breeding dates are March 1 to July 15, which includes lekking, nesting, and early-brood rearing. Therefore, reducing ground disturbance during these dates would minimize impacts to nesting birds. Additionally, mitigation measure WFM-3 would eliminate migratory bird and bat exposure to potentially toxic disposed waste water in evaporation ponds. As a result, this mitigation measure would reduce mortalities to migratory bird and bat species as a result of the Project. Mitigation measure WFM-4 would help minimize the potential for increased collisions and electrocutions of migratory bird species by increasing the visibility of power lines and limiting raptor perching locations. While new power lines fitted with anti-perching devices do not necessarily eliminate perching entirely, they are designed to discourage use of the power line as a hunting perch which could in turn decrease the potential for electrocution.

Mitigation measures WFM-2, SSS-1, and SSS-3 would require Cameco to avoid raptor and mountain plover nest sites identified within the areas of disturbance to prevent their removal, and to restrict activity during seasonal timing restrictions (April 15 to September 15 for burrowing owls, February 1 to July 31 for all other raptors, April 10 to July 10 for mountain plovers) within applicable protection buffers (i.e., 0.75 mile for ferruginous hawks, 0.25 mile for burrowing owl and mountain plover, 0.5 mile for all other raptors). As a result of this mitigation measure, Project-related impacts to raptor species and mountain plovers would be low and no take would be expected as a result of the Project.

Mitigation measure SSS-2 would help minimize the potential for increased predation on greater sage-grouse by limiting raptor and corvid perching locations. While new power lines fitted with anti-perching devices do not necessarily eliminate perching entirely, they are designed to discourage use of the power line as a hunting perch which could in turn decrease the potential for predation by raptors and corvids on greater sage-grouse.

Residual Impacts

Adverse impacts to wildlife from the Proposed Action would be minimized by application of the mitigation measures discussed above and by successful reclamation of surface disturbance to meet criteria reclaimed to the final reclamation standards presented in Section 2.3.9, Applicant-committed Environmental Protection Measures.

4.17.3 Resource Protection Alternative

Impacts to wildlife resources under the RPA generally would be the same as described for the Proposed Action, except that surface disturbance associated with each mine unit would be reduced. This would decrease the amount of wildlife habitat disturbed compared to the Proposed Action by 50 percent. Under the RPA, the potential for successful reclamation also would be improved, a closed loop drilling system would be implemented, the number of evaporation ponds would be reduced, enhanced reclamation goals and criteria would be established, and all new power lines would be buried. In addition, the RPA would reduce the number of shipments of material to 122 annual trips to the Smith Ranch-Highland facility as opposed to 325 annual trips, thereby reducing the potential for wildlife-vehicle collisions and indirect impacts from human presence and noise. Further details regarding the impacts of the various components of the RPA are discussed below in detail for each species group.

Under the RPA not all of the surface area within the mine units would be disturbed by construction activity as would occur under the Proposed Action. As shown in **Table 2.4-1**, the estimated construction disturbance would be approximately 50 percent of the area of each mine unit. During operations approximately 30 percent of the area within a mine unit would undergo interim reclamation and the remaining 20 percent would remain disturbed during operation.

4.17.3.1 Terrestrial Wildlife

Big Game Species

Potential direct impacts to big game species under the RPA would be same as described for the Proposed Action except there would be a reduction in the amount of habitat disturbed. Under the RPA 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing big game habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action. Additionally, given the enhanced reclamation goals and criteria established by the BLM, the likelihood of successful reclamation would increase. This would allow for big game use of reclaimed habitats within the GHPA sooner than under the Proposed Action.

Similar to the Proposed Action, based on the amount of suitable habitat surrounding the GHPA, and the lack of crucial winter range within or immediately adjacent to the GHPA, impacts to big game species would be low, limited primarily to displacement from areas of human activity and habitat alteration.

Small Game Species

Potential direct impacts to small game species under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action. Similar to big game habitat, given the enhanced reclamation goals and criteria established by the BLM, the likelihood of successful reclamation of small game habitat would increase. Specific impacts to waterfowl under the RPA would be the same as described for the Proposed Action except that a reduction in the number of evaporation ponds would reduce the potential for exposure to potentially toxic waste water within the evaporation ponds. Burying power lines also would eliminate any collision potential for small game birds within the GHPA.

Nongame Species

Potential direct impacts to small game species under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action.

4.17.3.2 Raptors and Other Migratory Birds

Similar to the Proposed Action, a number of raptor species (e.g., golden eagle, ferruginous hawk, prairie falcon, red-tailed hawk, Swainson's hawk, and great-horned owl) seasonally occupy the habitats found within the GHPA. Potential direct impacts to raptor species under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to15 percent and 7 percent under the Proposed Action. Similar to big game and small game habitat, the likelihood of successful reclamation of raptor habitat would increase, given the enhanced reclamation goals and criteria established by the BLM.

If present in or adjacent to the GHPA, breeding raptors could abandon breeding territories, nest sites, or lose eggs or young as a result of Project construction and operation activities that occur during the raptor breeding season (February 1 to July 31). Loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and, in the case of the golden eagle, would violate the Bald and Golden Eagle Protection Act. Loss of active nest sites could potentially impact populations of raptors that occur within the GHPA. Given the number of raptor nests present within the GHPA (40 documented from surveys in 2009, 2010, and 2011), it is likely that a reduction in habitat suitability and overall carrying capacity for raptors would occur if surface disturbance activities occurred within 0.75 mile of an active raptor nest. Furthermore, future nest sites and foraging habitat would be influenced by surface disturbance activities and increased human presence within the GHPA.

Potential direct impacts to other migratory bird species under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action. Similar to big game and small game habitat, the likelihood of successful reclamation of migratory bird habitat would increase, given the enhanced reclamation goals and criteria establish by the BLM. Impacts to breeding migratory birds could result in the abandonment of a nest site or territory, or the loss of eggs or young if Project activities were to occur during the breeding season (May 15 to June 30). Similar to raptor species, loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and could potentially impact populations of important migratory birds that occur within the GHPA. In addition, loss of an active nest would not be in compliance with BLM EO 13186.

As described in Section 2.4.8, Burial of New Power Lines, all new power lines under the RPA would be buried; therefore, no impacts to migrating or foraging raptor or migratory bird species would occur as a result of collision and electrocution.

Similar to the Proposed Action, to prevent livestock and wildlife exposure to potentially toxic waste water in the evaporation pond, Cameco has committed to installing fences around evaporation ponds to prevent access by wildlife and livestock, which would reduce the risk of exposure to terrestrial wildlife species (e.g., big game, small mammals, and reptiles). However, fencing would not reduce the risk of exposure to bird and bat species and impacts could occur as a result of exposure to potentially toxic waste water in the evaporation ponds. Additionally, under the RPA, a closed loop drilling system would

be implemented. The number of evaporation ponds would be reduced and the overall potential for bird and bat exposure to potentially toxic waste water would be reduced. Nonetheless, if waste water in the evaporation pond maintains toxic levels and exposure results in bird and/or bat mortalities, impacts may be significant.

4.17.3.3 Reptile and Amphibians

Potential direct impacts to reptile and amphibian species under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action. Similar to big game and small game habitat, the likelihood of successful reclamation of reptile and amphibian habitat would increase given the enhanced reclamation goals and criteria established by the BLM. Similar to the Proposed Action, implementation of VEG-1 would eliminate any impacts to amphibians that may occur as a result of water contamination in wetlands or riparian areas.

4.17.3.4 Special Status Wildlife Species

The following impact assessments focus on special status wildlife species, which include those species federally listed as threatened, endangered, proposed, or candidate species, as well as BLM sensitive species with the potential to occur within the GHPA. These species are identified in Section 3.17.2, Special Status Wildlife Species.

<u>White-tailed Prairie Dog (BLM Sensitive)</u>

Potential direct impacts to the white-tailed prairie dog under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Approximately 3 acres of disturbance to active white-tailed prairie dog colonies would occur during construction under the RPA as opposed to 5.6 acres under the Proposed Action. This would account for approximately 20 percent of the total active white-tailed prairie dog colonies within the GHPA. Approximately 0.05 acre of disturbance to active white-tailed prairie dog colonies would occur during Project operation.

Construction activities under the RPA would not be likely to permanently alter white-tailed prairie dog colonies within the GHPA. Habitat disturbance may actually encourage future colonization in the short-term, based on the availability of soft, permeable soils that would occur within the disturbed areas subsequent to the Project construction. Therefore, impacts to white-tailed prairie dogs would be low.

<u>Pygmy Rabbit (BLM Sensitive)</u>

Potential direct impacts to the pygmy rabbit under the RPA would be same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 32 acres of short-term and 13 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 3 percent and 1 percent of the existing habitat within the GHPA as opposed to 9 percent and 4 percent under the Proposed Action. Similar to the Proposed Action, given the extent of suitable sagebrush habitat in the surrounding region, the geographic location of the GHPA (i.e., on the periphery of the pygmy rabbit's known range), and the lack of documented occurrences during species-specific surveys, activities associated with the Project would not be anticipated to adversely affect the local population of this species. In addition, the likelihood of successful reclamation of sagebrush habitat would increase, given the enhanced reclamation goals and criteria established by the BLM. Therefore, impacts to the pygmy rabbit would be low.

<u>Bat Species (BLM Sensitive)</u>

Potential direct impacts to bat species under the RPA would be the same as described for the Proposed Action, except there would be a reduction in the amount of potential habitat disturbed. Under the RPA,

733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action. Similar to the Proposed Action, given the extent of suitable foraging and roosting habitat in the surrounding region and the lack of documented occurrences within the GHPA (HWA 2011b), activities associated with the Project would not be anticipated to adversely affect local populations of these species. In addition, the likelihood of successful reclamation of bat habitat would increase given the enhanced reclamation goals and criteria established by the BLM. Additionally, under the RPA, a closed loop drilling system would be implemented. The number of evaporation ponds also would be reduced and the overall potential for bat exposure to potentially toxic waste water would be reduced. Nonetheless, if waste water in the evaporation pond maintains toxic levels and exposure results in mortalities to BLM sensitive bat species, impacts may be significant.

Ferruginous Hawk (BLM Sensitive)

Potential direct impacts to ferruginous hawks under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action. In addition, the likelihood of successful reclamation of ferruginous hawk habitat would increase, given the enhanced reclamation goals and criteria established by the BLM. Under the RPA, all new power lines would be buried, therefore eliminating the potential for collision and electrocution. Impacts to the ferruginous hawk would be considered low under the RPA.

Burrowing Owl (BLM Sensitive)

Potential direct impacts to burrowing owls under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 378 acres of short-term and 148 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 8 percent and 3 percent of the existing habitat within the GHPA as opposed to 17 percent and 8 percent under the Proposed Action. Similar to the Proposed Action, due to the lack of occurrences of this species within the GHPA in recent years, impacts would be low.

Greater Sage-grouse (Federal Candidate, BLM Sensitive)

Potential direct impacts to greater sage-grouse under the RPA would be same as described for the Proposed Action except there would be a reduction in the amount of habitat disturbed (**Table 4.17-2**). In addition, the likelihood of successful reclamation of sagebrush habitat would increase given the enhanced reclamation goals and criteria established by the BLM. Burying all new power lines under the RPA would eliminate any collision potential for greater sage-grouse as well as eliminate new available perches for raptors and corvids. This would greatly reduce potential predation on greater sage-grouse as a result of the Project.

Wildlife surveys conducted within the GHPA over the past 3 years have documented greater sage-grouse during the spring and summer, including hens with their broods. Therefore, given the Project-related surface disturbance under the RPA, impacts to greater sage-grouse may occur and would be more pronounced if disturbance occurs within suitable habitat during the breeding season (March 1 to July 15).

WNv would continue to be a concern for the Project under the RPA due to the possibility of increased mosquito populations in the GHPA from the presence of evaporation ponds during operation. However, under the RPA, drilling mud pits would be eliminated and the number of evaporation ponds would be reduced relative to the Proposed Action. These changes would decrease the amount of available

Table 4.17-2 Greater Sage-grouse Habitat Potentially Impacted by the Project under the RPA

BLM FO	Lek Buffer/Habitat Type[a]	Existing Habitat (acres)	Estimated Surface Disturbance (acres)[b]	
			Short-term	Long-term
Lander	0.6 Mile NSO (Core Area[c])	0	0	0
	0.25 Mile NSO (Non-core Area)	0	0	0
	Nesting Habitat (Core Area[c])	0	0	0
	Nesting Habitat (Non-core Area – 2-mile buffer of an occupied lek)	2,119	260.3 (12 percent)	28.5 (1 percent)
Casper	0.6 Mile NSO (Core Area[c])	0	0	0
	0.25 Mile NSO (Non-core Area)	0	0	0
	Nesting Habitat (Core Area[c])	0	0	0
	Nesting Habitat (Non-core Area – 2-mile buffer of an occupied lek)	0	0	0
Total		**2,119**	**260.3 (12 percent)**	**28.5 (1 percent)**

[a] Lek buffers based on BLM IM 2010-012, Wyoming EO 2011-5, and BLM (2007).

[b] Includes disturbance associated with the mine units and Project infrastructure.

[c] Core areas are designated by the WGFD and are managed according to Wyoming EOr 2011-5.

mosquito habitat within the GHPA from the Project. Reducing the habitat and, therefore, the population of mosquitoes in the GHPA, especially species involved with bird-to-bird transmission of WNv, such as *Culex tarsalis*, would help to reduce the presence of the virus (APHIS 2012) in the GHPA and immediate vicinity relative to the Proposed Action.

Similar to the Proposed Action, historic mining disturbance has created a mosaic of partially reclaimed wildlife habitat within the GHPA. Therefore, the GHPA contains a limited amount of tall, mature sagebrush on south- and east-facing slopes that typically is required for greater sage-grouse winter habitat. In addition, no greater sage-grouse winter concentration areas have been identified within the GHPA. Although greater sage-grouse may use portions of the GHPA during the winter months, it is likely that higher quality winter habitat south and west of the GHPA supports the majority of wintering greater sage-grouse in the Project region and therefore impacts to wintering greater sage-grouse under the RPA would be low.

Brewer's Sparrow, Loggerhead Shrike, Sage Sparrow, Sage Thrasher (BLM Sensitive)

Potential direct impacts to these BLM sensitive bird species under the RPA would be same as described for the Proposed Action, except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 733 acres of short-term and 273 acres of long-term surface disturbance to potential habitat within the GHPA would occur. This would account for approximately 9 percent and 3 percent of the existing habitat within the GHPA as opposed to 15 percent and 7 percent under the Proposed Action. In addition, the likelihood of successful reclamation of migratory bird habitat would increase given the enhanced reclamation goals and criteria established by the BLM. Additionally, under the RPA, a closed loop drilling system would be implemented. The number of evaporation ponds also would be reduced

and the overall potential for bird exposure to potentially toxic waste water would be reduced. Nonetheless, if waste water in the evaporation pond maintains toxic levels and exposure results in mortalities to these species, impacts may be significant.

Mountain Plover (BLM Sensitive)

Potential direct impacts to mountain plovers under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 0.8 acre of short-term and 0.1 acre of long-term surface disturbance to potential habitat within the GHPA would occur as opposed to 1.3 acres and 0.1 acre under the Proposed Action. Similar to the Proposed Action, seed from reclaimed areas adjacent to the mountain plover habitat may disperse onto suitable mountain plover habitat, which would increase vegetation cover and reduce habitat quality.

Due to the documented presence of mountain plovers within the GHPA, additional impacts such as displacement and avoidance also would result from increased noise and human presence associated with construction and operation activities. If construction and operation activities occur during the mountain plover breeding season (April 10 to July 10) and surface-disturbance activities resulted in the loss of an active nest/s, impacts to the mountain plover could be significant.

Northern Leopard Frog and Great Basin Spadefoot (BLM Sensitive)

Potential direct impacts to the northern leopard frog and Great Basin spadefoot under the RPA would be the same as described for the Proposed Action except there would be a reduction in the amount of potential habitat disturbed. Under the RPA, 8 acres of short-term and 3 acres of long-term surface disturbance to potential habitat within the GHPA would occur, as opposed to 21 acres and 11 acres under the Proposed Action. Implementation of VEG-1 would eliminate any impacts to these 2 species that may occur as a result of water contamination in wetlands or riparian areas. Therefore, the Project under the RPA could impact individuals but would not likely cause a trend towards federal listing or loss of viability.

Mitigation

Mitigation measures under the RPA to further avoid, minimize, or mitigate Project-related impacts to wildlife and special status wildlife species, and their effectiveness would be the same as discussed under the Proposed Action with the exception of WFM-4 and SSS-2. These 2 mitigation measures are not needed to reduce collision and electrocution potential for small game birds, raptors, migratory birds, and special status bird species due to the lack of aboveground power lines under the RPA.

Residual Impacts

Adverse impacts to wildlife from the RPA would be minimized by application of the mitigation measures discussed for the Proposed Action and by successful reclamation of surface disturbance to meet reclamation criteria established in the Draft Lander RMP (BLM 2011b). The basis for these criteria is the NRCS ESD for each mapped ecological site found in the GHPA (USDA-NRCS 2011), as described in Section 2.4.7.1, Reclamation Success Criteria.

4.17.4 Irreversible and Irretrievable Commitment of Resources

No irreversible commitments would be anticipated for Wildlife and Fisheries Resources. A total of 1,206 acres of wildlife habitat (excluding developed areas) for the Proposed Action and 733 acres for the RPA would be incrementally lost during construction and operation, an irretrievable commitment of this resource. This would account for approximately 15 percent and 9 percent of the existing wildlife habitat within the GHPA. However, the majority of this habitat would be subsequently revegetated during operation (reestablishment of plant communities would require a minimum of 3 to 5 years and is further discussed in Section 4.13, Vegetation) until completion of final reclamation.

4.17.5 Relationship between Local Short-term Uses and Long-term Productivity

Long-term impacts could reduce use of the GHPA by wildlife and special status wildlife species. Additionally, short-term impacts associated with increased human presence and noise within the GHPA could displace animals from suitable cover, foraging, and breeding sites. However, due to the reclamation schedule and suitable habitat within and immediately adjacent to the GHPA, wildlife populations will continue to persist and utilize habitat within the GHPA.

5.0 Cumulative Impacts

5.0 Introduction

NEPA requires an assessment of potential cumulative impacts. Federal regulations (40 CFR 1500-1508) define cumulative impacts as:

> "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

Potential cumulative impacts are assessed at the resource level. The area of the CISA for past, present, and reasonably foreseeable future actions (RFFAs) that may generate cumulative impacts varies depending on the resource under consideration. RFFAs are defined as those projects within the geographic scope and timeframe of the Project, and were not considered to be speculative. Projects were considered non-speculative if there were: existing proposals, such as the submission of permit applications; a commitment of resources or funding; or for which the NEPA process has begun. The assessments assume the successful implementation of the environmental protection and mitigation measures, as well as compliance with applicable RMP restrictions and federal, state, and local regulations and permit requirements. The analysis includes both potential negative and positive impacts and is applicable to all action alternatives.

5.0.1 Types of Past, Present, and Reasonably Foreseeable Actions

Past disturbance within the GHPA and the surrounding area is primarily associated with historic uranium mining activities. This is discussed in more detail for the GHPA in Section 2.1.2, Existing Disturbance; Section 3.13, Vegetation; and Section 3.15, Water Resources (**Figure 3.15-4**). **Figure 3.13-1** depicts areas outside of the GHPA where past mining occured. Much of the areas disturbed by past mining have been reclaimed. Present disturbance and RFFAs shown in **Figures 5-1** and **5-2** are organized by the type of activity and include the following:

- Within the GHPA:
  - Reclamation of the Buss 1 Pit Lake (Revised Plan of Operations);
- Within the CISA, outside of the GHPA:
  - Mining exploration;
  - Mining operations;
  - Long-term management of uranium tailings (Gas Hills East and Gas Hills North tailings cap);
  - Reclamation of previous mining under the Wyoming AML program;
  - Oil and gas development; and
  - Potential road construction/relocation.

The area associated with the Buss Pit includes a groundwater fed impoundment, the Buss 1 Pit Lake. Reclamation of the Buss Pit most recently occurred in 1994 and 1995; currently, water volume and quality of the Buss 1 Pit Lake has stabilized, and vegetation has re-established over the site. The water quality at the Buss 1 Pit Lake does not meet the WDEQ-WQD Class III livestock standards due to a

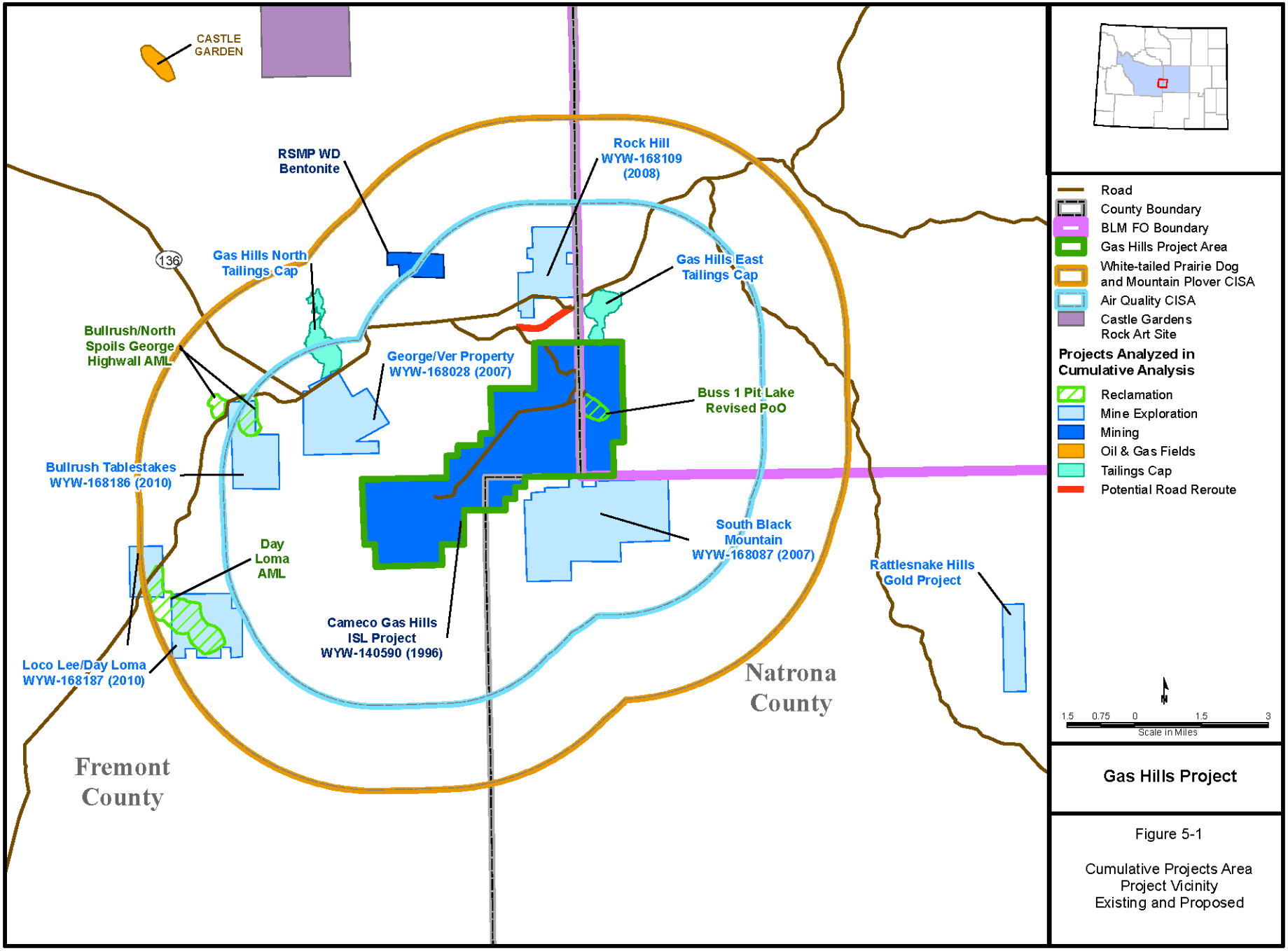
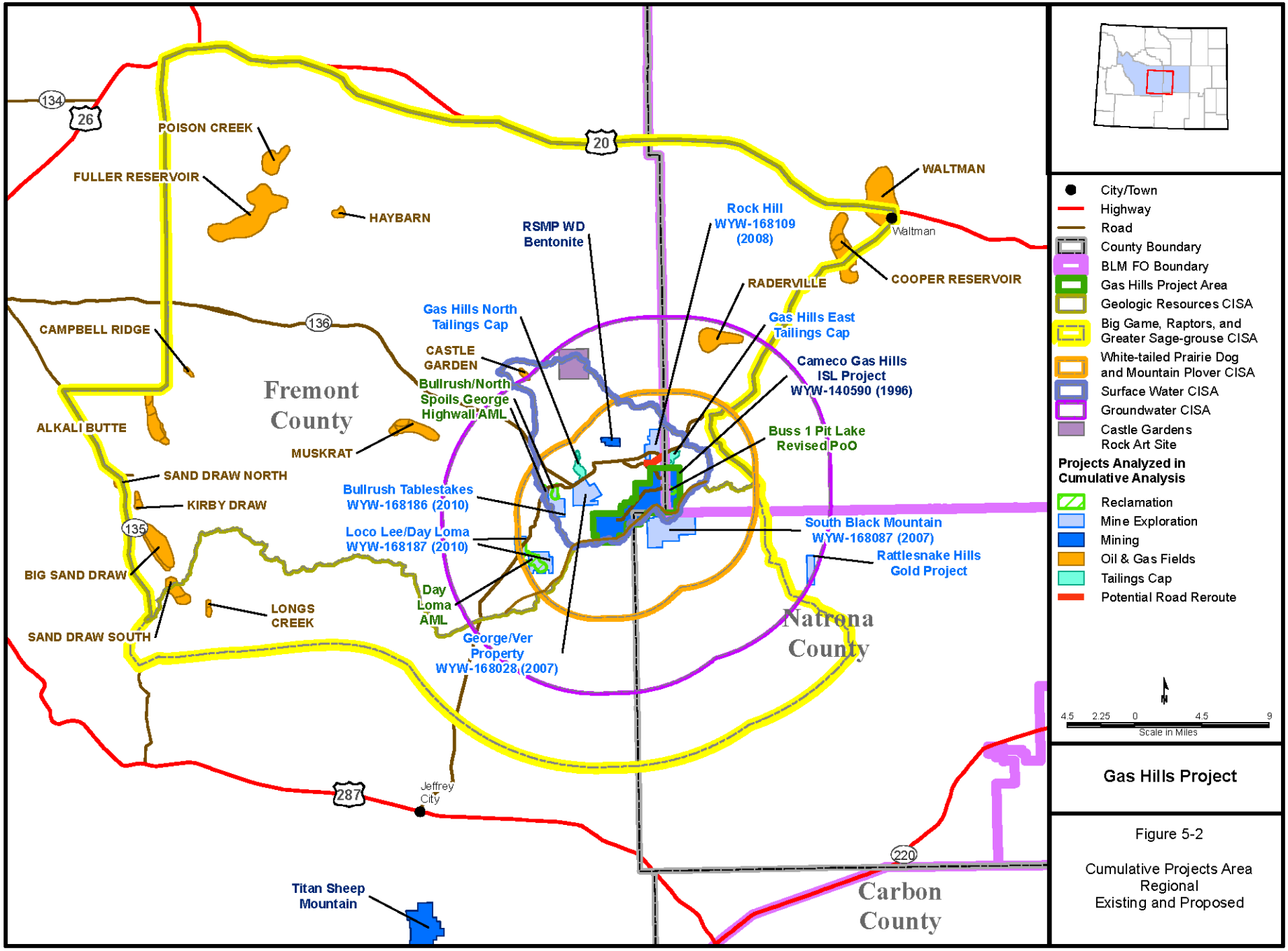


Figure 5-1

Cumulative Projects Area
Project Vicinity
Existing and Proposed



Gas Hills Project

Figure 5-2

Cumulative Projects Area
Regional
Existing and Proposed

low pH (3.8) and elevated aluminum concentrations. BLM considers the Buss 1 Pit Lake an acid lake, and as such has determined it requires remediation due to potential adverse impacts to the environment with the potential to adversely affect wildlife and groundwater.

Cameco has submitted a Revised PoO to the BLM Casper FO (PRI 2011a) outlining plans to mitigate the acid conditions at the Buss 1 Pit Lake. Cameco proposes to pump and treat the low pH water with lime to achieve a pH above 7.0 s.u. and monitor water level and water quality of the Buss 1 Pit Lake over the subsequent 15-year period. If within that 15-year period, the lake pH drops below 6.5 s.u. for 3 successive years, Cameco will commit to the Alternate Plan to backfill the Buss 1 Pit Lake with existing stockpiled overburden and topsoil. For the purposes of this analysis, the maximum potential disturbance of approximately 153 acres is assumed.

Disturbance associated with mining exploration (exploratory drilling) is assumed to cause less than 5 acres of disturbance per year, with all disturbances being reclaimed within the same year as it occurs. The exception to this is the Rattlesnake Hills Gold Project, which is authorized to disturb up to 40 acres through exploratory drilling. The remaining mining operations identified within the CISA use conventional mining methods.

Existing hazards or environmental damage from abandoned historic mining activities are identified and remediated by the WYDEQ AML division. The goal of AML activities is “to mitigate safety hazards and repair environmental damage from past mining activities, and to assist communities impacted by mining”, and reclamation efforts can result in re-disturbance of the entire area being reclaimed. Therefore, this analysis assumes 100 percent disturbance within boundaries identified for reclamation by this program.

Oil and gas activities require development of roads, pipelines, power distribution, well pads, and wells, which disturb only a portion of the surface area encompassed by each development. For the purposes of this analysis, 15 percent of the area within the boundary of each development is assumed to be disturbed.

Fremont County is planning to upgrade the Dry Creek Road and to potentially relocate approximately 1.4 miles of the road as shown in **Figure 5-1**. Assuming a conservative construction disturbance width of 150 feet, the new disturbance associated with relocation and construction of the Dry Creek Road would be 25 acres. With a running surface of 24 feet in width, the long-term disturbance associated with the road relocation would be approximately 4 acres.

5.0.2 Historic Land Use

Historic and existing land uses within the area surrounding the Project include private and commercial activities, such as:

- Grazing;
- Hunting and recreation (e.g., OHV use);
- Uranium exploration and extraction; and
- Oil and gas exploration and production.

As discussed in Section 2.1.2, Existing Disturbance, and Section 3.4, Land Use, these land use activities have resulted in the disturbance of approximately 15 percent of the GHPA or about 1,300 acres. Areas outside of the GHPA within the CISA have been disturbed by past mining for uranium, mining exploration, and ongoing oil and gas development activity.

5.0.3 Physical and Temporal Boundaries for Cumulative Impacts

The definition of the CISA is different for each resource because the physical boundaries are established to encompass the anticipated lateral extent of impacts for each resource. For example, the air quality effects are anticipated to extend beyond the Project boundary resulting in a CISA defined beyond the GHPA (**Figure 5-1**). Soil impacts are not anticipated to extend beyond the GHPA; therefore, the GHPA is defined as the CISA and the scope of potential cumulative activities is narrower. **Table 5-1** provides a description of the CISA for each resource.

Table 5-1 Cumulative Impact Study Areas

Resource	Cumulative Impact Study Area
Air Quality	GHPA and the area within 5-km of the Project boundary.
Cultural Resources and Native American Traditional Cultural Properties	GHPA and the following additional study areas: Castle Gardens Rock Art site; Gas Hills Mining District; and Casper to Lander Road.
Geology	From the Beaver Rim north and west to Highway 20/26 and Road 135 near Moneta.
Land Use	No impacts to land use are anticipated from the Project; therefore, no cumulative impacts are anticipated and no CISA is defined.
Livestock Grazing	Portions of the Matador, Blackjack, and Diamond Springs grazing allotments within the GHPA, as well as the entire Gas Hills grazing allotment.
Noise	No impacts from noise are anticipated from the Project; therefore, no cumulative impacts are anticipated and no CISA is defined.
Paleontological Resources	GHPA.
Public Health and Safety	The impact area for radiation includes the GHPA and the communities of Jeffrey City and Waltman. The impact area for the storage of hazardous materials is the GHPA. The impact area for transportation of hazardous materials includes the GHPA and designated transportation routes to the Smith Ranch-Highland facility.
Recreation	GHPA and immediate surrounding area within approximately 2 miles of the boundary for recreation.
Socioeconomics	Fremont and Natrona counties with additional attention to Converse County to the extent warranted to include potential effects of processing Project-related ore at the existing Smith Ranch-Highland facility.
Soils	GHPA.
Transportation	GHPA and designated transportation routes to the Smith Ranch-Highland facility, as well as the primary access roads approaching the GHPA.
Vegetation	The portions of the Matador, Blackjack, and Diamond Springs grazing allotments that are within the GHPA, as well as the entire Gas Hills grazing allotment.
Visual Resources	The GHPA and areas from which the Project would be visible (**Figure 4.14-1**)

Table 5-1 Cumulative Impact Study Areas

Resource	Cumulative Impact Study Area
Water Resources-Surface Water	Upper Canyon Creek-Deer Creek and Fraser Draw subwatersheds, which contain all Project disturbance in the GHPA.
Water Resources-Groundwater	GHPA and the area within 10 miles of the GHPA, corresponding to the area where groundwater drawdown impacts could occur.
Wild Horses	No impacts to wild horses are anticipated from the Project; therefore, no cumulative impacts are anticipated and no CISA is defined.
Wildlife and Fisheries Resources	GHPA and beyond as defined by big game, raptors, and special status wildlife species distribution and/or sensitive habitat.

5.0.4 Current and Planned Project

Tables 5-2 and **5-3** detail the past, present, and RFFA projects considered in the cumulative analysis. These projects are shown in **Figures 5-1** and **5-2**.

Table 5-2 Current Projects within the Gas Hills Project CISA

Project	Owner/Proponent	Type	Project Disturbance (size) (acres)[a]	County
Mine Exploration				
George/Ver Property	Strathmore Resources Inc.	Uranium Mine (exploration)	5 (1,631)	Fremont
Loco Lee/Day Loma	Strathmore Resources Inc.	Uranium Mine (exploration)	5 (1,876)	Fremont
Rock Hill	Strathmore Resources Inc.	Uranium Mine (exploration)	5 (1,211)	Fremont
Bullrush Table Stakes	Strathmore Resources Inc.	Uranium Mine (exploration)	5 (1,105)	Natrona
South Black Mountain	Strathmore Resources Inc.	Uranium Mine (exploration)	5 (3,567)	Natrona
Mining				
RSMP WD Bentonite	US Bentonite	Bentonite	120 (386)	Fremont
Long-term Land Management				
Gas Hills East Tailings Cap	Umetco/DOE	Tailings Cap	331 (331)	Fremont/ Natrona
Gas Hills North Tailings Cap	Pathfinder Mines Corp/ DOE	Tailings Cap	347 (347)	Fremont
Oil and Gas Fields				
Alkali Butte	Legacy Reserves Operating, SM Energy Company, Texaco	Oil	238 (1,590)	Fremont

Table 5-2 Current Projects within the Gas Hills Project CISA

Project	Owner/Proponent	Type	Project Disturbance (size) (acres)[a]	County
Big Sand Draw	BP America Production Co, Howell Petroleum, Legacy Reserves, Texaco	Oil	338 (2,254)	Fremont
Campbell Ridge	Black Bear Oil Corp, Mosbacher Production Co	Oil	19 (129)	Fremont
Castle Garden	Atlantic Richfield Co, Richardson Operating Co.	Oil	30 (198)	Fremont
Cooper Reservoir	Bill Barrett Corp, Chevron USA Inc., Integrity Oil and Gas, Intoil Inc.	Oil	525 (3,499)	Natrona
Fuller Reservoir	Ambrit Energy Corp, ANR Production Co, Boyd Exploration, Delta Exploration Co, Marathon Corp, Nortex Gas & Oil Co, Petroleum Resource Management Corp, Richardson Operating Co.	Oil	788 (5,252)	Fremont
Haybarn	Coastal Oil & Gas Corp, Gas Ventures LLC	Oil	45 (298)	Fremont
Kirby Draw	Brower Oil & Gas inc, Sinclair Oil, True Oil LLC	Oil	42 (277)	Fremont
Longs Creek	Atlantic Richfield Co, Legacy Reserves Operating LP	Oil	32 (213)	Fremont
Muskrat	Atlantic Richfield Co, Legacy Reserves Operating LP, MKM Oil Co, Shannon Oil, Wold Oil	Oil	235 (1,565)	Fremont
Poison Creek	Encana Oil and Gas USA Inc, Huber JM Corp, Richardson Operating Co.	Oil	194 (1,295)	Fremont
Raderville	Bummer Bruce L, Butler Oil Co, LOCO, M-3 Industries, Nucor Oil & Gas Inc, USA Exploration & Production LLC	Oil	274 (1,829)	Natrona
Sand Draw North	BP America Production Co, Legacy Reserves Operating LP, Thorofare Resources, Inc.	Oil	60 (403)	Fremont
Sand Draw South	BP Exploration Inc, First Energy Properties, Mar/Reg Investments, Shannon Oil, Thorofare Resources Inc, WESCO Operating Inc	Oil	156 (1,037)	Fremont

Table 5-2 Current Projects within the Gas Hills Project CISA

Project	Owner/Proponent	Type	Project Disturbance (size) (acres)[a]	County
Waltman	Bill Barrett Corp, Chevron USA Inc, Coastal Oil & Gas Corp, Double Eagle Petroleum Co, Jo Scott Enterprises Inc, Lario Oil & Gas Co, Moncrief WA JR, Petro-Canada Resources USA Inc, Williams Production RMP Co LLC	Oil	649 (4,328)	Natrona

[a] For the purposes of cumulative analysis, oil and gas activities were assumed to disturb, a maximum of 15 percent of the area within the project boundaries, based on an average number of wells at the end of 2007 per development (BLM 2011b; WOGCC 2011a), and an average disturbance for each well of 6 acres (BLM 2011b).

Table 5-3 Planned Projects within the Gas Hills Project CISA

Project	Owner/Proponent	Type	Project Disturbance (acres)	County
Mining				
Gas Hills In-situ Recovery (ISR) Uranium Mine Project	Cameco Resources	Proposed Uranium Mine	1,315 (8,518b[a])	Fremont/ Natrona
Reclamation				
Buss 1 Pit Lake Revised PoO[b]	Cameco/Power Resources, Inc.	Uranium Mine Pit Lake Reclamation	153	Natrona
Bullrush/North Spoils/George Highwall	AML Division	Uranium Mine Reclamation	318	Fremont
Day Loma	AML Division	Uranium Mine Reclamation	1,333	Fremont
Road Construction				
Dry Creek Road	Fremont County	Road Relocation	25	Fremont

[a] Total area within the Project boundary (GHPA).

[b] Located within the GHPA boundary. Cameco acquired the Buss Pit property (WDEQ-LQD Permit No. 438) from the TVA. Cameco reclaimed the Buss open pits area from 1994 through 1995 in accordance with an approved WDEQ-LQD reclamation plan. Cameco has submitted a Plan of Operations to the BLM (Casper FO) to address impacted water quality within the Buss 1 Pit Lake.

5.0.5 Actions Not Included in the Cumulative Analysis

Projects identified in the vicinity of the GHPA, but not considered in the cumulative analysis include the following:

- Titan Uranium Inc. Sheep Mountain underground and open-pit uranium mine utilizing heap leaching and solvent extraction, located 8 miles south of Jeffrey City, Wyoming in Sections 17, 20, 21, 22, 27, 28, 29, 32, and 33 of T28N, R92W;
- UR Energy, Lost Creek ISR uranium mine, located in Sections 17 to 20 and 29 to 31, T25N, R92W and Sections 13, 24 and 25 of T25N, R93W;
- Evolving Gold, Rattlesnake Hills Gold Exploration Project, located in Section 24 and 25 of T32N, R88W; and
- Strathmore Resources, Gas Hills Project, located in T33N R89W and T33N R90W.

Sheep Mountain and Lost Creek are proposed uranium mines located south of U.S. 287 and south of Jeffrey City. The Rattlesnake Hills Exploration Project is located to the east of the Project. These activities are not within the geographic scope of the area analyzed for cumulative impacts.

Strathmore Resources Inc. has filed a Letter of Intent with U.S. NRC stating intent to file a PoO for a heap leach operation in the Gas Hills area during the first quarter of 2013. Because the project has not yet been fully defined to the U.S. NRC and a PoO has not been submitted to the BLM, the Project is considered speculative and is not included in the analysis of cumulative impacts.

The BLM has approved installation of meteorological towers for collection of site-specific wind energy data for 2 possible projects within the vicinity of the GHPA. However, since no plans have been submitted to the BLM for implementation of wind farms, these projects are considered speculative and are not included in the cumulative impact analysis.

5.1 Air Quality

The CISA for air quality encompasses the GHPA and the area within 5 km of the Project boundary based on the estimated maximum extent of impacts from emissions of the primary pollutant, PM. The projects within the CISA considered in the analysis of cumulative impacts to air quality include mining exploration projects, Cameco's Revised PoO for reclamation of the Buss 1 Pit Lake, 2 DOE long-term management projects, and 2 AML projects (see **Figures 5-1** and **5-2**).

5.1.1 Pollutant Emissions

As discussed in Section 4.1.2.1, Pollutant Emissions, impacts to air quality from the Proposed Action would result in concentrations of priority pollutants that are no more than one-third of the allowable concentrations under the NAAQS. The projects within the CISA would consist of construction activities similar to the Project that, when added to the emissions from the Project, could result in a doubling of impacts to air quality. A doubling of impacts would still result in concentrations of pollutants below the NAAQS. Impacts to air quality from the RPA would be slightly less than for the Proposed Action, and much less under the No Action Alternative. Therefore, cumulative air quality impacts would not be anticipated under any Project alternative, especially given the distance between the projects within the CISA and the localized nature of impacts from emission sources.

5.1.2 Greenhouse Gases

GHG emissions resulting from combustion of fossil fuels from Project-related activities under the Proposed Action would be approximately 222,000 tpy CO_2e, as shown in **Table 4.1-9**. In addition, indirect emissions of GHGs resulting from generation of electric power purchased for the Project would be approximately 4,200 tpy CO_2e for a total of approximately 226,000 tpy CO_2e of GHG emissions. This

total is about 0.003 percent (3 thousandths of 1 percent) of total annual U.S. emissions of GHGs. An equivalency calculation indicates that the total CO_2e emissions from the Project would release about the same amount of GHGs as the energy use for approximately 1,000 average households in the U.S. Impacts of other projects within the CISA to air quality would involve similar types of construction activity as the Project but over a shorter time frame, likely contributing a lower level of GHG emissions. GHG emissions would be reduced by approximately 2 percent under the RPA and by 90 percent under the No Action Alternative.

The cumulative effects generally attributed to increased atmospheric GHG levels include, but are not limited to, melting permafrost, sea level rise, changing global climate patterns, redistribution of plant and animal species, redistribution of disease vectors, and altered precipitation regimes, both spatially and temporally. Current state of the science does not have the ability to link any particular instance of GHG emissions or sequestration to any specific climate-related environmental effects.

5.2 Cultural Resources and Native American Concerns

The CISA encompasses the GHPA, as well as the Gas Hills Mining District, portions of the Casper to Lander Road (generally along the upper, north facing slopes of the Beaver Divide), and Castle Gardens Rock Art Site. Activities within this area include mine exploration and reclamation, mining, oil and gas development, and potential road construction or relocation. Following Native American consultation, the CISA may be expanded to include additional study areas outside of the GHPA.

From the 1950s to the early 1980s, much of the surface area within and adjacent to the CISA was extensively mined for uranium, employing both underground and surface mining methods. Approximately 15 percent of the land surface within the GHPA has been disturbed by previous conventional mining and 10 percent of the land surface has undergone subsequent reclamation. Additionally, exploration drilling and associated access road construction completed since the 1950s has disturbed portions of the GHPA. Federally mandated protection of historic properties came into place after 1966; therefore, it is assumed that disturbance prior to this time was likely to have damaged or destroyed historic properties within the GHPA at least in the 15 percent of lands that had been disturbed. Subsequent to federal historic preservation mandates, cultural resources inventories have been conducted for any actions involving federal lands, and adverse effects to historic properties avoided or mitigated as appropriate. Improvements to inventory procedures were made in 1981, leading to more reliable inventories. However, earlier surveys may be repeated or checked to ensure compliance with more current views of appropriate inventories and mitigation. Avoidance through project redesign is the preferred method of mitigation; however, when avoidance was not feasible, data recovery or other forms of mitigation were implemented prior to ground-disturbing activities.

Unavoidable adverse effects to known historic properties located in proposed disturbance areas associated with any Project alternative would be mitigated in accordance with the PA and approved treatment. In addition, any previously unknown historic properties potentially discovered during surface disturbance activities would be mitigated per the PA. However, if data recovery is necessary to mitigate unavoidable adverse effects to 3 historic properties described in Section 4.2.2.1, Impacts on Cultural Resources and Native American Traditional Values, the process would recover a substantial amount of data but ultimately the site would be destroyed by the undertaking. This would constitute an impact from the Project which, when combined with past actions, would represent a cumulative impact. Because the amount of disturbance that would occur is greatest under the Proposed Action, it would have the highest potential for an impact.

Portions of the GHPA are visible from a segment of the historic Casper to Lander Road. Recent archaeological investigations (Larson et al. 2012) of the Casper to Lander Road found that the segment had been destroyed by previous disturbance; therefore, no impacts to the road from the Project are anticipated under any alternative and no cumulative effects to the road would occur.

The Castle Gardens Rock Art Site, which is considered sacred by Native American groups, is located approximately 8 miles north of the GHPA. Although the site would not be physically or visually impacted by the Project, there is concern that an increase in the numbers of people in the area may increase visitation to the site and consequently increase the potential for vandalism. However, since Project employees would not be living in the Gas Hills area and the Castle Gardens Road is not proposed as a primary or alternative access route, no vandalism as a result of any Project alternative is anticipated. Therefore, it is not necessary to analyze the cumulative effects of other projects within the CISA on the Castle Gardens Rock Art Site.

5.3 Geology

The CISA for geology and mineral resources encompasses the GHPA, and extends from the Beaver Rim to the (south), to Highway 20/26 (north), and from Road 135 north to Moneta (west) (**Figure 5-2**). This designation is based on regional geology and transportation corridors. Projects considered in the analysis include ongoing mining exploration 2 DOE long-term management projects, AML reclamation projects, oil and gas exploration and development, and other mining projects.

5.3.1 Geologic Hazards

Projects within the CISA for geology and mineral resources are not located on steep slopes near Beaver Rim, but are located in other areas with steep slopes prone to landsliding. However, given appropriate design or avoidance, no Project alternative is expected to contribute to cumulative impacts to landslides in the CISA. Oil and gas projects in the CISA could include deep wastewater disposal wells with the remote potential to induce an increase in seismic activity similar to those described for the Project (Section 4.3.2.1, Geologic Hazards).

5.3.2 Mineral Resources

During construction, operation, and reclamation under the Proposed Action and the RPA, access to minerals such as oil, gas, coal, or sand and gravel within the GHPA would be limited; however, there is little potential for development of these minerals (Section 4.3.2, Proposed Action Alternative). Historic mining within the CISA limits the development of mineral resources to the extent that uranium ore has been removed from the subsurface within areas of past mining and is no longer available for extraction. Ongoing projects within the CISA also limit access to mineral resources within their project boundaries which, along with the Project, would result in a cumulative impact to mineral resources. However, this limitation would have no cumulative impact on access to regional mineral resources outside of the Project development boundaries. Under the No Action Alternative, mineral extraction within the GHPA would not contribute to cumulative impacts.

5.4 Land Use

No Project alternative is anticipated to impact land ownership, special management areas, or areas with special designations. Cumulative impacts to mineral development, grazing, and recreation are described in Sections 5.2, 5.5, and 5.9, respectively. Therefore, it is not necessary to analyze cumulative impacts to land use from other activities within and adjacent to the GHPA.

5.5 Livestock Grazing

The CISA for livestock grazing resources encompasses portions of the Matador, Blackjack, and Diamond Springs grazing allotments within the GHPA, as well as the entire Gas Hills grazing allotment (**Figure 5-3**). Existing projects and RFFAs that would be expected to produce incremental and cumulative impacts within the CISA include historic uranium mines that have been or are in the process of being reclaimed (including the Buss 1 Pit Lake), 2 DOE long-term management projects, existing mining exploration, a bentonite mine, and a potential road relocation. The existing projects and RFFAs in

the vegetation CISA are shown in **Figure 5-3** and the projects and associated detail are summarized in **Tables 5-2** and **5-3**. **Table 3.5-1** summarizes the livestock type, livestock number, season of use and active AUMs for each grazing allotment in the CISA.

The CISA encompasses approximately 59,050 acres. Existing projects and RFFAs in the vegetation CISA are found in the Gas Hills grazing allotment. Projects other than the Gas Hills Project have a total approved surface disturbance of approximately 2,159 acres, which at an average stocking rate of 30 acres per AUM currently impacts approximately 72 AUMs. Approval of the Proposed Action would add approximately 1,315 acres of disturbance, corresponding to impacts to 61 AUMs for a total of 3,474 disturbed acres impacting 133 AUMs within the CISA. This disturbance represents approximately 5.9 percent of all lands within the CISA. The Project would contribute less than half of the surface disturbance due to existing and RFFAs in the CISA during the life of the Project, equivalent to approximately 2.2 percent of the area within the CISA. Approval of the RPA would result in less surface disturbance within mine units; however, because mine units would remain fenced during construction, operation, and reclamation cumulative impacts to livestock grazing from the RPA

would be the same as for the Proposed Action. Livestock grazing would not be impacted under the No Action Alternative; therefore, the Project would not contribute to cumulative impacts.

The past, present, and reasonably foreseeable future projects would cumulatively reduce available acres from active grazing. This would reduce the associated available active AUMs for the lifetime of mine operations until such time that reclamation is deemed successful (approximately 3 to 15 years depending on the vegetation cover type). If impoundments or other permanent features are developed during reclamation of the historic mine areas that prevent the restoration of native vegetation, these areas would represent a permanent loss of forage within the CISA.

5.6 Noise

The Project is not anticipated to result in noise impacts. Therefore, it is not necessary to analyze cumulative impacts from noise.

5.7 Paleontological Resources

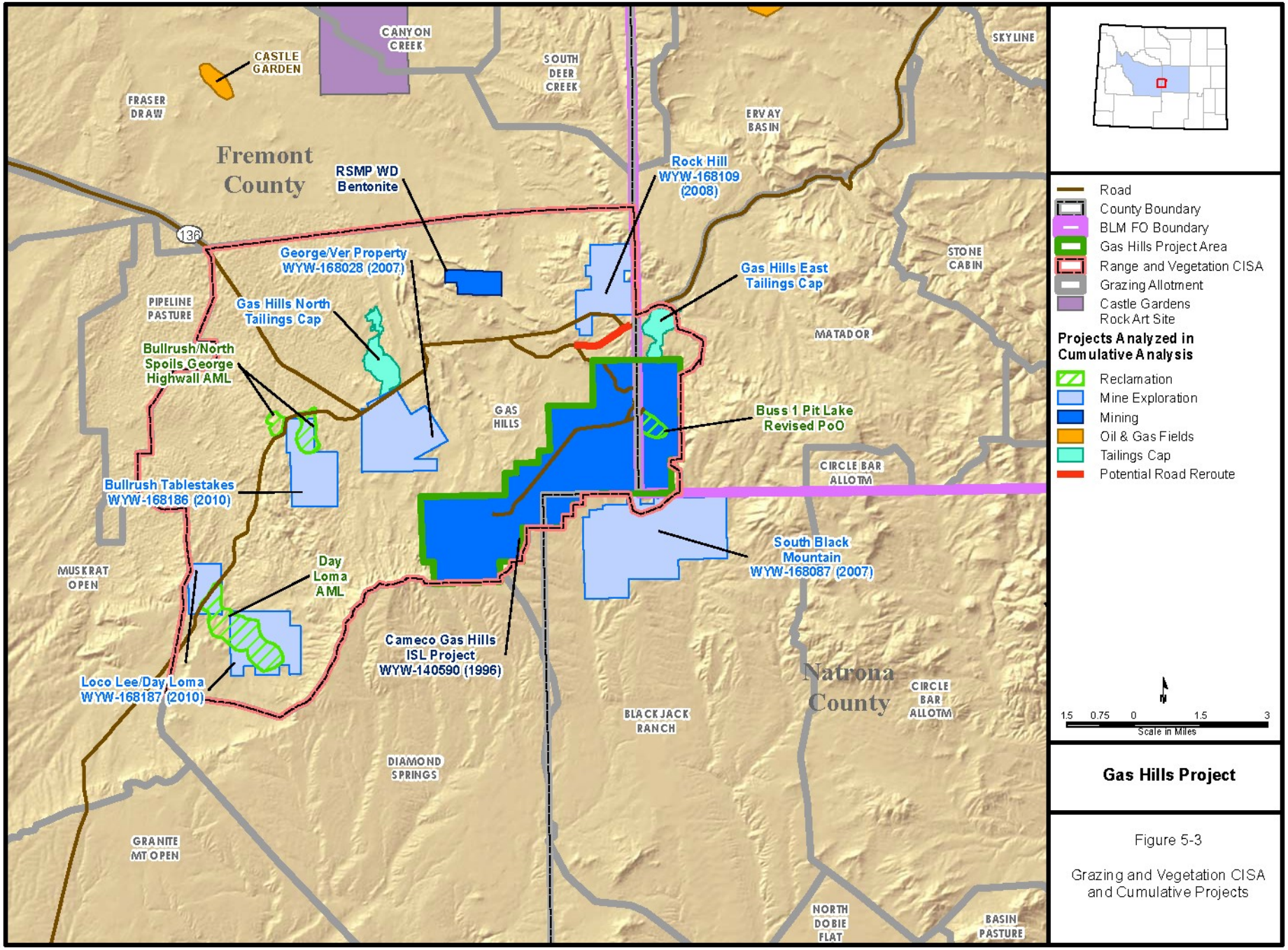
The CISA for paleontological resources is the GHPA. Cumulative impacts to paleontological resources could result from surface disturbance related to the Proposed Action or the RPA, reclamation of the Buss 1 Pit Lake, unauthorized collection, and natural erosion processes in the CISA. Mining reclamation projects are not likely to result in impacts to paleontological resources because these projects involve re-disturbance of areas disturbed by past mining activity. With the implementation of the recommended mitigation measures (Section 4.7.2, Proposed Action Alternative), approval of the Proposed Action or RPA, when added to past, present, and RFFAs would not be anticipated to result in cumulative impacts to paleontological resources. Approval of the No Action Alternative would not result in impacts to paleontological resources, and therefore no cumulative impacts would occur.

5.8 Public Health and Safety

The CISA for radiation includes the area within 50 miles of the GHPA; specifically including the communities of Jeffrey City and Waltman (U.S. NRC 2004). The CISA for the storage of hazardous materials includes the GHPA. The CISA for transportation of hazardous materials includes the GHPA and designated transportation routes to the Smith Ranch-Highland facility.

5.8.1 Exposure to Radioactive Materials

Since impacts from radiation exposure under any action alternative are expected to be negligible (U.S. NRC 2004) within the CISA, it is not necessary to analyze cumulative impacts from radiation.



Gas Hills Project

Figure 5-3

Grazing and Vegetation CISA and Cumulative Projects

5.8.2 Hazardous Materials and Solid Waste

Hazardous materials transported to and stored within the GHPA under the Proposed Action are listed in **Table 4.8-1,** and are listed in **Table 4.8-3** for the RPA. Materials transported or stored within the GHPA under the No Action Alternative would be limited to fuel. In addition to these materials, reclamation of the Buss 1 Pit Lake would require transport, storage, and use of an estimated 60 to 80 tons of concentrated lime (100 percent pure) (PRI 2011a). Based on delivery of 20 tons per truck, this would represent 4 deliveries of a hazardous substance to the reclamation site. Any spill prevention or emergency response plans would be implemented under permits associated with reclamation of the Buss 1 Pit Lake, but are likely to be similar to those implemented under all Project alternatives. With proper implementation of spill prevention and/or emergency response plans, cumulative impacts associated with the storage and use of hazardous substances would not be anticipated.

Under the Proposed Action or RPA, the Project would contribute to a small increase in the amount of non-radioactive solid waste and radioactive waste that would be generated in the area. Since the Project would be the only uranium mining operation in the CISA, the amount of waste generated by the Project would represent the cumulative amount of waste generated in the CISA. Although the No Action Alternative would be anticipated to generate less waste than the action alternatives, this also would represent the total cumulative amount within the CISA. Since the impacts would be expected to be minimal due to the disposal of waste in existing off-site repositories, it is not necessary to analyze cumulative impacts from waste generation in the CISA.

5.8.3 Transportation of Materials

The Proposed Action and RPA would result in a very small increase in the annual amount of hazardous materials shipped along the identified transportation routes; no increase in the amount of hazardous materials shipped would be anticipated from the No Action Alternative. Reclamation of the Buss 1 Pit Lake would contribute an additional estimated 4 shipments of hazardous material to the GHPA. Based on the anticipated number of trips for the Project (**Table 4.8-3**), transportation of materials for reclamation of the Buss 1 Pit Lake would represent a maximum 1 percent increase in the number of trips, if all shipments for the reclamation occurred within 1 year. On I-25 and the major federal highways, the transportation of hazardous materials to the GHPA would represent a very small increase over existing conditions due to the existing high truck transport volume. On Wyoming State Route 136, this increase would represent a proportionately larger increase in traffic and a small increase in the risk of a spill during transport. Although it is not anticipated that the identified past and present actions and RFFAs would use Wyoming State Route 136 for transport of materials, oil and gas activities in the region would be anticipated to have a cumulative interaction with hazardous materials transport on Wyoming State Route 136. Based on the projected low probability of an accident resulting in a release under the Proposed Action and the RPA, the impact of the increase in hazardous materials transportation is anticipated to be small. With proper implementation of spill prevention and/or emergency response plans, cumulative impacts associated with the transport of hazardous substances are not anticipated.

5.9 Recreation

The CISA for recreation resources is defined as the GHPA and immediate surrounding area within approximately 2 miles of the Project boundary. Adverse cumulative impacts to recreational resources within the CISA would include both closures and restrictions from activities associated with the Proposed Action or RPA and Buss 1 Pit Lake reclamation, reduced quality of recreational experiences due to noise and activity, and a reduction in recreational opportunities as a result of less available acreage. Restrictions and closures during construction and operation would impact recreationists in the short term, while the need for recreational users, such as hunters, to avoid areas that have been heavily developed would continue in the long term.

5.10 Socioeconomics

The CISA for social and economic resources is the same 3-county area as the direct effects study area discussed in Section 3.10, Socioeconomics. The past and present actions and RFFAs are identified in **Tables 5-2** and **5-3**, and their locations shown in **Figures 5-1** and **5-2**. Social and economic effects of past and present actions are reflected in the affected environment information presented in Section 3.10, Socioeconomics. As a result, any potential cumulative effects for past and present actions are included in the discussion of environmental consequences in Section 4.10.1, No Action Alternative.

As noted in **Tables 5-2** and **5-3**, all of the oil and gas fields have been operating and are considered past and present actions. Most of the mining projects are either reclamation projects, which require small numbers of employees, or projects in the exploration/development stages, which currently have small work forces with uncertain future employment and production levels. Employment levels for these projects currently have been estimated at fewer than 75 workers. The Sheep Mountain Uranium Project in southern Fremont County is in the early stages of a BLM NEPA review, and anticipates employment of 210 full-time workers and 40 contractors (BRS 2011). Combined with the 85 to 96 workers required for the Proposed Action or the RPA, the total anticipated employment required for all of the RFFAs would range from 410 to 421 direct employees, plus approximately 275 workers in indirect positions. With more than 4,000 unemployed individuals in the 3-county CISA, most, if not all, of the jobs would be expected to be filled locally, and any cumulative population increase would be expected to be minor, distributed among Lander, Riverton, Casper, and the surrounding smaller communities. Under these circumstances, the existing housing and community facilities and services resources would be sufficient to accommodate the cumulative effects of the projects.

Because no adverse social or economic effects have been identified for the Proposed Action or the RPA, and because the cumulative employment and population effects would be minor, no cumulative adverse social or economic effects would be anticipated for these alternatives. Under the No Action Alternative, there would be no change from current conditions for employment or rent by Cameco; therefore, no positive or adverse cumulative impacts would occur.

5.11 Soils

The CISA for soil resources consists of the GHPA. Past, present, and RFFAs that contribute to impacts to soil resources in the study area include the Buss 1 Pit Lake remediation, and existing 2-track, natural surface, graveled, and paved roads. Historic impacts to soil resources also include activities such as wildfire, recreation, grazing, and other natural and anthropogenic activities within the analysis area.

The Buss 1 Pit Lake remediation work could involve minimal surface disturbance to soil resources if water treatment in the pit lake is successful, or 153 acres additional acres of surface disturbance if the Buss I Pit Lake water pH dips below 6.5 during the monitoring period for 3 successive years. The additional disturbance for reclamation of the Buss 1 Pit Lake would involve backfilling with stockpiled spoil followed by topsoiling with available stockpiled topsoil and suitable subsoils. If backfilled, bare soils would be subject to wind and water erosion until successful reclamation and revegetation was achieved.

Reasonably foreseeable projects in the soil CISA have a total approved surface disturbance of approximately 153 acres. In addition, approximately 409 acres of land is currently disturbed by previous activities in the CISA (**Table 3.13-1**). Approval of the Proposed Action would add approximately 1,315 acres to the disturbance for a total of 1,877 acres. The Proposed Action would represent approximately 70 percent of the total cumulative disturbance from existing and reasonably foreseeable project disturbance. Approval of the RPA would add approximately 783 acres of disturbance, representing approximately 58 percent of the total cumulative disturbance of 1,345 acres. The additional impacts to soils as a result of the Proposed Action or RPA would be long-term during the life of the Project, but would be reclaimed at the end of the life of the Project. These disturbances could result in significant impacts to soil resources if successful interim and final reclamation was not achieved. Existing

disturbances within the CISA would be reclaimed under the No Action Alternative which would result in reducing cumulative disturbances by 40 acres.

5.12 Transportation

The CISA for transportation is the GHPA and designated transportation routes to the Smith Ranch-Highland facility, as well as the primary access roads approaching the GHPA. Past, present, and RFFAs that could contribute to impacts to transportation in this study area include the potential relocation of Dry Creek Road by Fremont County. Adverse impacts associated with the Proposed Action and RPA would include an increase in Project-related traffic and accidents within the CISA, as well as greater maintenance needs on new and existing roads as heavy truck traffic increases. A potential benefit would be an improved and regularly maintained road network that could provide access for recreationists and RFFA's. With increased access and use comes an increased probability of accidents with passenger vehicles and trucks that are utilizing the same roads. No impacts would be anticipated from the No Action Alternative, therefore, cumulative impacts were not analyzed.

5.13 Vegetation

The CISA for vegetation resources encompasses the Gas Hills grazing allotment, and the portions of the Diamond Springs, Matador, and Blackjack Ranch grazing allotments found in the GHPA (**Figure 5-3**). Existing and reasonably foreseeable projects that would be expected to produce incremental and cumulative impacts within the CISA include historic uranium mines that have been or are in the process of being reclaimed, mine exploration, and an existing bentonite mine. The existing and reasonably foreseeable projects in the vegetation CISA are shown in **Figure 5-3** and the projects and associated detail are summarized in **Tables 5-2** and **5-3**.

Existing and reasonably foreseeable projects in the vegetation CISA, other than the Project, have a total approved surface disturbance of approximately 2,159 acres. Approval of the Proposed Action would add approximately 1,315 acres to the disturbance for a total of 3,474 acres; the Project would represent approximately 38 percent of the total cumulative disturbance from existing and reasonably foreseeable project disturbance. Approval of the RPA would add approximately 783 acres to the cumulative disturbance, for a total of 2,595 acres (approximately 27 percent of the total cumulative disturbance). The additional impacts to vegetation as a result of the Proposed Action or RPA would be long-term during the life of the Project, but would be reclaimed at the end of the Project.

Past and present actions and RFFAs would cumulatively and incrementally reduce vegetation cover types until such time that reclamation is deemed successful and native plants are re-established. As several of the past projects are in reclamation, many of these impacts would be reduced as these historic mines are successfully reclaimed. If impoundments or other permanent features are developed during reclamation of the historic mine areas that prevent the restoration of native vegetation, these areas would represent a permanent loss of vegetation in the CISA. Impacts to vegetation associated with the uranium and bentonite mines would be similar, as described in Chapter 4.0.

Cumulative losses for vegetation resources potentially would include the reduction of native ecosystem functions such as soil stability, erosion control, livestock and wildlife forage, and wildlife habitat. The removal of shrub species from these areas would result in a long-term change in vegetation structure since it would take up to 10 to 15 years for shrub species of similar stature to become re-established in these areas. Indirect impacts to vegetation resources associated with surface disturbance-related activities would include fugitive dust accumulation, fragmentation, and introduction and/or spread of noxious weeds and invasive species. Fugitive dust from development activities can adversely impact native vegetation communities and alter vegetative composition (USEPA 2008; USFWS 2008). Livestock grazing has and would continue to influence vegetation composition and structure in the CISA. Potential for overgrazing may increase as land is converted to mining and transportation uses. Fragmentation of the landscape by the cumulative impact of multiple linear and localized surface disturbances can impact native vegetative communities and native plant species. Impacts from fragmentation could include the

loss of suitable habitat, more exposure to disturbances, increased competition, and decreased pollination.

Approval of the No Action Alternative would result in reclamation of approximately 40 acres, or 2 percent of the cumulative disturbance. Successful reclamation incrementally would reduce impacts to vegetation within the defined CISA; however, challenges to reclamation would be the same as described for the Proposed Action and RPA.

5.13.1 Noxious and Invasive Weed Species

Surface disturbance activities from implementation of the Proposed Action or RPA, combination with reclamation of the historic mines within the vegetation CISA (**Figure 5-3**) could further spread noxious weed and invasive species into previously undisturbed areas, and may increase the acreage and population numbers of currently established noxious weed and invasive species. Surface-disturbing activities would be greatly reduced under the No Action Alternative. The combined impacts associated with surface-disturbing activities resulting from past and present actions and RFFAs likely would result in increased landscape fragmentation which could increase the potential for noxious weed and invasive species to spread and establish proportional to the amount of surface disturbance.

Implementation of noxious weed management techniques such as minimizing surface disturbance activities, herbicide spraying of known populations, and the reclamation of disturbed areas associated with past and present projects and RFFAs would minimize the potential for noxious weed and invasive species to spread or establish. Additionally, the majority of the surface disturbance-related impacts within the CISA would be reclaimed, minimizing the introduction and/or spread of noxious weeds and invasive species resulting from the Project.

5.13.2 Special Status Plant Species

Cumulative impacts to special status plant species would be increased for cedar rim thistle and rocky mountain twinpod due to Project alternatives, and past, present, and RFFA projects within the vegetation CISA.

5.13.2.1 Cedar Rim Thistle

Within the vegetation CISA, potential habitat for the Cedar Rim thistle is found in the following existing and reasonably foreseeable projects: the Project, Day Loma, and South Black Mountain. Within the existing and foreseeable projects other than the Gas Hills Project, there are 13 acres of potential habitat as identified by WYNDD distributional modeling for this species (HWA 2011a). Approval of the Proposed Action would add approximately 587 acres to the disturbance for a total of 600 acres of cumulative disturbance in potential habitat for this species, representing approximately 98 percent of the cumulative disturbance for this species. The RPA would add approximately 294 acres of cumulative disturbance in potential habitat for this species, representing approximately 96 percent of the total of 307 acres. No additional disturbance to Cedar Rim thistle habitat would occur under the No Action Alternative.

Direct impacts to habitat from the Proposed Action or RPA would be minimized through the proposed mitigation described in Section 4.13.2.3, Special Status Plant Species. Cumulative indirect impacts, including effects from the spread of noxious and invasive weed species and fugitive dust, would be minimized through the implementation of applicant-committed environmental protection measures, (Section 2.3.9, Applicant-committed Environmental Protection Measures). However, these impacts could increase slightly as a result of the Project, and other past, present, and RFFAs.

5.13.2.2 Rocky Mountain Twinpod

Within the vegetation CISA, potential habitat for the Rocky Mountain twinpod is found in the following existing and reasonably foreseeable projects: the Project and the Buss 1 Pit Lake reclamation. Within the existing and foreseeable projects other than the Gas Hills Project, there are 52 acres of potential

habitat as identified by WYNDD distributional modeling for this species (HWA 2011b). Approval of the Proposed Action would add approximately 464 acres to the disturbance for a total of 516 acres of disturbance in potential habitat for this species; the Project would represent approximately 90 percent of the total of existing and reasonably foreseeable project disturbance for this species. Approval of the RPA would add approximately 232 acres of disturbance, for a total of 284 acres of cumulative disturbance; the RPA would represent approximately 82 percent of the total. No additional disturbance to Rocky Mountain twinpod habitat would occur under the No Action Alternative.

Direct impacts to habitat from the Proposed Action or RPA would be minimized through the proposed mitigation described in Section 4.13.2.3, Special Status Plant Species. Cumulative indirect impacts, including effects from the spread of noxious and invasive weed species and fugitive dust, would be minimized through the implementation of applicant-committed environmental protection measures (Section 2.3.9, Applicant-committed Environmental Protection Measures). However, these impacts could increase slightly as a result of the Proposed Action or RPA, and other past, present, and RFFAs.

5.14 Visual Resources

There has been considerable prior disturbance to the characteristic landscape in the viewshed of the Project from past and present activities, particularly previous surface mining for uranium. Some of the disturbance still exists in the area, which has led to designation of a portion of the westerly extent of the GHPA as being in need of visual rehabilitation. Section 3.14, Visual Resources, explains the “rehabilitation” designation in greater detail.

The Proposed Action or the RPA would have low to moderate adverse visual effects for short-term (1- to 3-year) periods in limited locations, throughout the duration of construction activities for each of the 5 mine units. There would be similar effects during decommissioning. The cumulative effects would be of similar low significance. After completion of the active life of the Project, there would be little or no residual visual effects; similarly, there would be minimal cumulative visual effects. There would be minor, positive cumulative visual effects after successful reclamation of the portion of Mine Unit 3 that is located in the area indicated as being in need of visual rehabilitation from prior mining activities. Under the No Action Alternative, reclamation of 1 linear feature and the Carol Shop would provide minor positive cumulative visual effects after successful reclamation.

5.15 Water Resources

5.15.1 Surface Water Resources

The CISA for surface water resources consists of the Upper Canyon Creek-Deer Creek and Fraser Draw subwatersheds. Surface water resources could be impacted from the cumulative ground disturbance from the Project and the projects listed in **Table 5-2** and **Table 5-3** that are located within the surface water resources CISA, including the Rock Hill, RSMP WD Bentonite, Bullrush/Tablestakes, and George/Ver projects, the majority of the Bullrush/North Spoils/George Highwall AML projects, a small portion of the South Black Mountain project, 2 DOE long-term management projects, 1 potential road relocation, and the Castle Garden Oil and Gas Field, each of which contribute to the total surface disturbance in the area.

Existing and proposed disturbance in the surface water resources CISA, not including the Project, totals 1,191 acres. This existing disturbance represents less than 1 percent of the surface water resources CISA. Construction disturbance under the Proposed Action would add 1,315 acres, or approximately 52 percent of the cumulative disturbance in the surface water resources CISA. Construction of the RPA would add 783 acres of disturbance, or approximately 40 percent of cumulative disturbance in the surface water CISA.

Increased ground disturbance due to development of future projects, including further expansion of the road network to accommodate additional resource development, may have adverse impacts similar to

those discussed in Section 4.15, Water Resources. These impacts could include temporary increases in storm-water runoff and increases in suspended and dissolved solids concentrations in runoff when ground disturbance is occurring, generally during construction and reclamation. Each new project disturbing more than 1 acre would be required to obtain a construction storm water discharge permit, and to prepare and adhere to an approved SWPPP. Once successful reclamation of disturbed ground is complete, the effects to surface water resources are expected to be minimal.

5.15.2 Groundwater Resources

The CISA for cumulative impacts for groundwater resources is the GHPA and the area within 10 miles of the GHPA. Projects within the CISA include mining reclamation, mining exploration, ongoing oil and gas production, long-term management of uranium tailings, and a bentonite mine. These projects are not anticipated to have an impact on groundwater quantity or quality. Groundwater quality impacts from the Proposed Action or RPA during mine construction and operation would be limited to mine units through monitoring and groundwater management, as described in Section 4.15.2.2, Proposed Action Alternative. Final locations of these wells would be determined through future hydrological investigations, but impacts would not be expected to extend beyond the GHPA boundary.

Groundwater quality in each mineable unit would be restored either to pre-mining baseline water quality, or to the pre-mining Wyoming Class of Use for the groundwater if the pre-mining baseline water quality cannot be achieved for 1 or more constituents. In the event that only pre-mining Wyoming Class of Use can be achieved for some constituents in 1 or more of the mineable units, groundwater quality in the GHPA would be impacted and there would be a cumulative impact to water quality in the area in that water quality could be degraded for one or more constituents due to the Project.

During groundwater restoration, impacts to groundwater levels would extend beyond mine units and potentially beyond the boundaries of the GHPA. Under WDEQ guidelines, Cameco would be required to restore water levels to pre-mining groundwater flow patterns, thus restoring baseline groundwater flow patterns. Therefore, cumulative impacts to groundwater would be the same as for the Proposed Action and RPA. Impacts associated with deep disposal of Project wastewater are not anticipated under any Project alternative. Therefore, cumulative impacts from deep disposal do not need to be analyzed. No impacts to groundwater from the No Action Alternative are anticipated; therefore, no cumulative impacts would occur.

5.15.3 Water Use

The CISA for cumulative impacts to water use is the GHPA and the area within 10 miles of the GHPA. As noted above in the discussion of groundwater quantity impacts, the projects that occur within the CISA include reclamation of historic mining activity, mining exploration, ongoing oil and gas production, and long-term management of uranium tailings. These projects are not anticipated to have an impact on water use. A bentonite mining project also is located within the CISA but this project is not anticipated to have an impact on water use. Therefore, the only project that could potentially contribute to cumulative impacts to water use would be Cameco's proposed Project.

The administration of water rights by the WSEO dictates which water rights take precedence over others, and new water use would not be allowed to impact current water users or interstate agreements. Therefore, the Proposed Action or the RPA, along with other activities within the CISA would not be allowed to impact other water users within the CISA and no cumulative impacts would be anticipated. No impacts to water use would be anticipated under the No Action Alternative; therefore no cumulative impacts would occur.

5.16 Wild Horses

No Project alternative is anticipated to cause impacts to wild horses (Section 4.16, Wild Horses). The nearest wild horse herd management area is 5 miles from the GHPA. Therefore, it is not necessary to analyze cumulative impacts to wild horses. Wildlife and Fisheries

The CISAs for wildlife resources encompass important wildlife habitat surrounding the GHPA (**Figures 5-1** and **5-2**). The big game, raptors, and greater sage-grouse CISAs include portions of Mule Deer Herd Unit 646 (Sweetwater) buffered 15 miles from the GHPA and all of Mule Deer Herd Unit 648 (Beaver Rim). For the white-tailed prairie dog and mountain plover CISAs, a 5-mile buffer of the GHPA was determined to be adequate, as it covers previous mining reclamation in the region, which is potentially mountain plover and white-tailed prairie dog habitat. The white-tailed prairie dog and mountain plover CISAs also include small game (other than greater sage-grouse), migratory birds, reptiles, and amphibians.

As with all other resources, the cumulative analysis for wildlife resources focuses on past, present, and RFFAs presented in **Table 5-2**. Each Project alternative assumes that: 1) human use of the CISAs would increase with the implementation of the Project alternative; 2) wildlife habitats currently are at their respective carrying capacities in and adjacent to the GHPA; and 3) the overall region has been previously impacted by at least some level of historic and current development activities and will be impacted by RFFAs. As described in Section 4.17, Impacts to Wildlife and Fisheries, fisheries resources are not impacted by any project alternative; therefore, cumulative impacts were not analyzed.

5.17 Terrestrial Wildlife

Cumulative impacts to wildlife resources would be directly related to habitat loss, habitat fragmentation, animal displacement, and direct mortalities. Past, present, and RFFAs for activities in the wildlife CISAs have resulted, or would result, in the direct disturbance of habitat (**Table 5-4**). A portion of the cumulative disturbance surface area has been, or would be, reclaimed. The reclaimed areas and areas associated

Table 5-4 Cumulative Wildlife Habitat Disturbance

CISA	Total Acres of Habitat	Acres Disturbed by the Proposed Action (percent of total habitat area)	Acres of Habitat Disturbed by Past, Present, and RFFAs[a] (percent of total habitat area)	Total Acres of Habitat Disturbed (percent of total habitat area)
Proposed Action				
Big Game, Raptors, and Greater Sage-grouse	1,099,534	1,315 (<1 percent)	4,878 (<1 percent)	6,189 (<1 percent)
White-tailed Prairie Dog and Mountain Plover[b]	118,129	1,315 (1.5 percent)	1,790 (1.2 percent)	3,101 (2.6 percent)
Resource Protection Alternative				
Big Game, Raptors, and Greater Sage-grouse	1,099,534	783 (<1 percent)	4,878 (<1 percent)	5,657 (<1 percent)
White-tailed Prairie Dog and Mountain Plover[b]	118,129	783 (<1 percent)	1,790 (1.5 percent)	2,569 (2.2 percent)

[a] See **Tables 5-2** and **5-3** for a breakdown of cumulative projects.

[b] The white-tailed prairie dog and mountain plover CISAs also cover small game (excluding greater sage-grouse) migratory birds, reptiles, amphibians, pygmy rabbit, special status bat species, special status migratory bird species, and special status amphibian species.

with habitat conversion would be capable of supporting wildlife use; however, species composition and densities likely would change.

In general, cumulative impacts from the Proposed Action or RPA would increase in the CISAs during the life of the Project but would gradually decrease upon completion of the Project as final reclamation occurs. Cumulative impacts from past, present, and RFFAs within the CISA for the Proposed Action or RPA would include:

- Reduction of suitable habitat/habitat fragmentation. While surface disturbance generally corresponds to associated wildlife habitat loss, accurate calculations of cumulative wildlife habitat loss cannot be determined because the direct impacts of habitat disturbance are species-specific and dependent upon: 1) the status and condition of the population(s) or individual animals being affected; 2) seasonal timing of the disturbances; 3) value or quality of the disturbed sites; 4) physical parameters of the affected and nearby habitats (e.g., extent of topographical relief and vegetative cover); 5) value or quality of adjacent habitats; 6) the type of surface disturbance; and 7) other variables that are difficult to quantify (e.g., increased noise and human presence). However, estimated surface disturbance calculations (**Table 5-4**) are still a useful indicator of habitat loss because as forage, foraging and/or hunting habitats, and breeding, nesting, and rearing habitats are removed, overall quality of wildlife habitat also will decrease. In areas where development has occurred, habitat fragmentation may have resulted in the disruption of seasonal patterns or migration routes. Historic, current, and future developments in the CISAs have resulted, or would result, in the reduction of carrying capacities as characterized by the amount of available cover, forage, and breeding areas for wildlife species. Current or previous surface disturbance in the CISAs primarily results from mining exploration and reclamation as well as oil and gas development. Other activities such as livestock grazing also contribute to cumulative impacts on wildlife habitat (e.g., reduction of biomass).
- Animal displacement. Displaced individuals of any species could be forced into less suitable habitats, possibly resulting in subsequent effects of deteriorated physical condition, reproductive failure, mortality, and general distress as important habitat is reduced and animals are displaced. Loss of habitat/forage consequently could result in increased competition between and among species for available resources. Some wildlife species, such as raptors, would be susceptible to these cumulative impacts since encroaching human activities in the CISAs have resulted, or would result, in animal displacement in areas that may be at their relative carrying capacity for these resident species. Many of the local wildlife populations (e.g., small game, migratory birds) that occur in the CISAs likely would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from incremental development. Displacement of individuals also could reduce the hunting success or wildlife viewing in the area, as described in Section 4.9.2, Proposed Action Alternative
- Decreased reproduction success. A decrease in reproductive success and physical condition from increased energy expenditure due to physical responses to disturbance could lead to increased mortality.
- Increased vehicle/wildlife collisions. An increase in traffic levels on roadways has the potential to increase vehicle/wildlife collisions and increased human utilization of resources through hunting and other recreational activities that would expose wildlife to potential human harassment, either inadvertent or purposeful.
- Increased hunting pressure. An increase in human activity in the CISAs may provide the opportunity for additional hunting pressure on game species such as mule deer, pronghorn, and small game species due primarily to increased public access.

Based on these cumulative impacts, ongoing and future development in the CISAs would cumulatively and incrementally reduce the ability of wildlife habitats in the CISAs to support wildlife populations at their current levels for the lifetime of the anticipated cumulative Project-related development, production, and reclamation. Cumulative impacts would continue until such time that reclamation is deemed successful (approximately 3 to 20 years depending on the vegetation cover type). Successful reclamation is assumed to establish wildlife habitats to pre-disturbance conditions.

5.18 Special Status Wildlife Species

Special status wildlife species would be cumulatively impacted by past, present, and RFFAs and the resulting direct and indirect impacts for the Proposed Action and RPA generally would be the same as discussed above in Section 5.17, Terrestrial Wildlife. On BLM-managed lands (and state of Wyoming lands and private lands in many cases), operators/proponents are typically required to conduct pre-construction surveys in potential or known habitats of threatened, endangered, or otherwise special status wildlife species. These surveys would help determine the presence of any special status wildlife species or extent of habitat, and protective measures would be developed in consultation with the BLM, WGFD, and USFWS to avoid or minimize direct disturbance in these habitats. No cumulative impacts to special status wildlife species would be anticipated under the No Action Alternative.

6.0 Consultation and Coordination

The 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 EIS should address. The purpose of the scoping process is to actively acquire input from all interested parties to identify important issues, concerns, and potential impacts that require analysis in the EIS, as well as eliminate insignificant issues and alternatives from detailed analysis. The scoping process provides opportunities for all BLM offices, cooperating agencies, other interested parties, and the public to have meaningful involvement early in the BLM decision-making process.

The BLM, with input from cooperating agencies, developed a Draft EIS and sent it to all interested parties for public review and comment. Following a 45-day public comment period, all comments received will be compiled and responses prepared for incorporation as an appendix to the Final EIS. The BLM will then modify, clarify, and/or correct the Draft EIS, as appropriate, to prepare a Final EIS, with input from cooperating agencies. Once complete, the Final EIS is distributed to all interested parties for 1 final review and comment. Following a 30-day comment period on the Final EIS, the BLM will decide whether to develop a ROD and issue approval of Cameco's PoO.

6.1 Agency Participation and Coordination

The BLM is the lead federal agency for this EIS, which was prepared by the BLM Lander FO in Lander, Wyoming. A third-party contractor, AECOM Environment (AECOM), was retained to gather data and prepare documents to support EIS preparation at the direction of the BLM. Specific regulations require the BLM to consult with federal, state, and local agencies about the potential of the project and alternatives to affect sensitive environmental and human resources. The BLM initiated these consultation activities through the scoping process and has maintained them through regular meetings regarding key topics (e.g., alternatives and impact analyses) with cooperating agencies throughout the NEPA process. Cooperating agencies have been actively involved in the BLM's process for preparing, reviewing, and creating this Draft EIS, as well as in developing mitigations to reduce impacts from the Project. Other federal, state, and local agencies were consulted throughout the process to address specific issues, as needed.

The BLM invited interested federal, state, and local agencies to serve as cooperating agencies for preparation of the EIS; based on agency responses, the following agencies are serving in this role (see Section 1.5, Public Participation, **Table 1.5-3**);

- Federal Agencies
  - U.S. Environmental Protection Agency
  - U.S. Fish and Wildlife Service
- State Agencies
  - State of Wyoming (including 16 departments)
- Local Agencies
  - Fremont County

Cooperating agencies provided input at specific stages during EIS development, as summarized in **Table 1.5.4**. Input was used to ensure the RPA included agency concerns and that all applicable land and resource management for all agencies was considered in the evaluation of the Project.

6.2 Consultation

Federal laws require the BLM to consult with certain federal and state agencies and entities and Native American tribes (40 CFR 1502.25) during the NEPA decision-making process. The BLM also is directed to integrate NEPA requirements with other environmental review and consultation requirements to reduce paperwork and delays (40 CFR 1500.4-5). The following section discusses activities conducted during the NEPA process to meet these requirements.

6.2.1 Tribal Consultation

Federal agencies are directed by the NHPA to consult with any Indian tribe that attaches religious and cultural significance to historic properties that may be affected by an undertaking. Tribal consultation is a government-to-government relationship and is the active, affirmative process of: 1) identifying and seeking input from appropriate Native American governing bodies, community groups, and individuals; and 2) considering their interests as a necessary and integral part of the BLM's decision making process. The aim of consultation is to involve affected Native American groups in the identification of issues and the definition of the range of acceptable management options.

Under the auspices of the American Indian Religious Freedom Act of 1978, Executive Order 13007, the Native American Graves Protection and Repatriation Act of 1990, and the NHPA, the BLM must take into account the effects of land use decisions on places (i.e., physical locations) of cultural value to American Indian groups. The BLM works in cooperation with American Indian tribes to coordinate and consult before making decisions or approving actions that could result in changes in land use, physical changes to lands or resources, changes in access, or alienation of lands. Federal programs are required to be carried out in a manner sensitive to American Indian concerns and tribal government planning and resource management programs.

Formal consultation under Section 106 of the NHPA, as amended, began on May 6, 2011, when the BLM distributed letters to 14 tribes notifying them of the BLM's intent to prepare an EIS for the Gas Hills Project. The reader is referred to Section 3.2.2.2, Native American Consultation, for more information on the tribal consultation process. Input from the tribes will be requested throughout the development of the document and will continue up to and during Project construction to identify impacts and design mitigation measures that address impacts, pursuant to NHPA and other relevant historic preservation laws and regulations, along with the American Indian Religious Freedom Act and Executive Order 13007 (entitled "Indian Sacred Sites").

6.2.2 Fish and Wildlife Consultation

To comply with Section 7(c) of the ESA of 1973, BLM consults with the USFWS to develop a Draft Biological Assessment for proposed projects followed by a final Biological Assessment published concurrently with the Final EIS. Given the lack of threatened and endangered species in the GHPA the BLM does not anticipate the need for formal consultation on this Project.

6.3 Public Involvement

NEPA requires full disclosure and open public participation in the federal decision-making process, including those projects proposed by non-federal proponents that require federal approval. There are two key points during the development of an EIS that the general public is invited to participate: 1) during the scoping period, and 2) during the 45-day review period of this Draft EIS.

Refer to Section 1.5.1, Public Participation and Scoping Summary, for information on the NOI publication, public scoping meetings, and a summary of scoping issues. The BLM continued to accept written comments throughout all stages of project development. Summaries of both written comments and those received at scoping meetings are included in the Scoping Report, and are available online at the BLM webpage (http://www.blm.gov/wy/st/en/info/NEPA/documents/lfo/gashills.html). The issues and

concerns identified by the public during the scoping period are summarized in Section 1.5.1.1, Primary Issues from Public Scoping.

The release of this Draft EIS will be followed by a 45-day comment period. Comments received during this period will be reviewed and substantive comments will receive a response. Substantive comments and corresponding responses will be provided as an appendix to the Final EIS. Comments will be used to modify, clarify, and/or correct the Final EIS as appropriate.

6.4 List of Agencies, Organizations, and Persons to Whom Copies of this EIS are Sent

6.4.1 Federal Agencies

Bridger-Teton National Forest
Bureau of Indian Affairs
Bureau of Land Management, Field Office and District Office; Casper, Wyoming
Bureau of Land Management, Field Office; Lander, Wyoming
Bureau of Land Management, State Office; Cheyenne, Wyoming
Bureau of Land Management, District Office; Worland, Wyoming
National Park Service, National Trails System; Salt Lake City, Utah
Natural Resource Conservation Service; Riverton and Casper, Wyoming
Nuclear Regulatory Commission
U.S. Army Corps of Engineers, Wyoming Regional Office
U.S. Department of Energy; Washington, DC
U.S. Environmental Protection Agency; Denver, Colorado
U.S. Fish and Wildlife Service; Cheyenne, Wyoming
U.S. Fish and Wildlife Service; Denver, Colorado
U.S. Fish and Wildlife Service; Lander, Wyoming
U.S. Fish and Wildlife Service; Washington, DC
U.S. Forest Service; Lander, Wyoming
Western Area Power Administration

6.4.2 State Agencies

Water Development Commission
Wyoming Department of Agriculture
Wyoming DEQ, Administration
Wyoming DEQ, Air Quality Division
Wyoming DEQ, Land Quality Division
Wyoming DEQ, Solid and Hazardous Waste Division
Wyoming DEQ, Water Discharge Group
Wyoming DEQ, Water Quality Division
Wyoming Oil and Gas Conservation Commission
Wyoming Department of Revenue, Ad Valorium Tax
Wyoming Department of Transportation
Wyoming Game and Fish Department
Wyoming Livestock Board
Wyoming Natural Resources Conservation Service
Wyoming Office of State Lands and Investment

Wyoming Office of the Governor
Wyoming Oil and Gas Conservation Commission
Wyoming Outdoor Council
Wyoming SHPO
Wyoming State Engineer's Office
Wyoming State Forestry Division
Wyoming State Geological Survey
Wyoming State Grazing Board
Wyoming State Historic Preservation Office
Wyoming State Land and Farm Loan
Wyoming State Lands and Investments
Wyoming State Parks and Historic Sites, and Trails
Wyoming Trails Program
Wyoming Travel and Tourism
Wyoming Wildlife Federation

6.4.3 County and Local Agencies

Carbon County Commissioners
City of Casper City Council
City of Lander
Fremont County Association of Governments
Fremont County and Prosecuting Attorney
Fremont County Commissioners
Fremont County Natural Resource Planning Committee
Fremont County Planning Office
Fremont County Road Department
Fremont County Solid Waste Disposal District
Fremont County Weed and Pest District
Lander Chamber of Commerce
Lower Wind River Conservation District
Natrona County Commissioners
Natrona County Conservation District
Popo Agie Conservation District
Riverton Chamber of Commerce
Sweetwater County Commissioners
Wyoming County Commissioners' Association

6.4.4 Elected Officials

George Bagby, State Representative
John Barrasso, U.S. Senator
Eli Bebout, State Senator
Stan Blake, State Representative
Bill Brauer, City of Casper Council Member
Bob Brechtel, State Representative
Cale Case, State Senator
Roy Cohee, State Representative
Bernadine Craft, State Representative
Mike Enzi, U.S. Senator
Mary Meyer Gilmore, State Representative
Keith Gingery, State Representative
W. Patrick Goggles, State Representative
Steve Harshman, State Representative
Rae Lynn Job, State Senator
Grant C. Larson, State Senator
Cynthia Lummis, U.S. Representative
Del McOmie, State Representative
Marty Martin, State Senator
David Miller, State Representative
Kenyne Schlager, City of Casper Mayor
Lisa A. Shepperson, State Representative
Charles K. Scott, State Senator
William “Jeb” Steward, State Representative
Tom Walsh, State Representative
Ronald O. Warpness, City of Riverton Mayor
Mick Wolfe, City of Lander Mayor

6.4.5 Tribal Organizations

Cheyenne River Sioux Tribe
Crow Creek Sioux Tribe
Crow Nation
Eastern Shoshone Tribe
Fort Peck Assiniobine Sioux tribes
Lower Brule Sioux Tribe
Northern Arapaho
Northern Cheyenne Tribe
Oglala Sioux Tribe
Rosebud Sioux Tribe
Shoshone Bannock Tribes
Sisseton Wahpeton Oyate Tribe
Standing Rock Sioux Tribe
Ute Indian Tribe
Yankton Sioux Tribe

6.4.6 Libraries

Fremont County Library
Natrona County Public Library
Riverton Branch Library

6.4.7 Media

Casper Star Tribune
KCWC Public Television
KOVE/KDLY Radio
KTRZ Radio
KTWO Radio
Lander Journal
Riverton Ranger Newspaper
Soshoni Pioneer
Wyoming Public Television

6.4.8 Organizations

Alliance for Historic Wyoming
American Wildlands
Audubon Council of Wyoming
Biodiversity Conservation Alliance
Boone and Crockett Club of America
Bowhunting Preservation Alliance
Campfire Club of America
Center for Biological Diversity

Delta Waterfowl Foundation
Ducks Unlimited
Friends of Wild Wyoming deserts
Greater Yellowstone Coalition
Land and Water Fund of the Rockies
Mule Deer Foundation
Museum of the American West
National Historic Trails Center Foundation
National Rifle Association of America
National Shooting Sports Foundation
North American Grouse Partnership
Oregon-California Trails Association
Pope and Young Club
Powder River Basin Resource Council
Public Lands Foundation
Quails Unlimited
Quality Deer Management Association
Rocky Mountain Elk Foundation
Ruffed Grouse Society
Sierra Club Wyoming Chapter
Sportsmen for Fish and Wildlife of Wyoming
The Nature Conservancy
The Peregrine Fund, Inc.
The Wilderness Society
Theodore Roosevelt Conservation Prtnrship
Trout Unlimited
Western Watershed Project
Whitetail's Unlimited
Wild Earth Guardians
Wildlife Forever
Wind River 4x4 Association
Wind River Program, Jackson Hole Land and Trust
Wind River Recreationists
Wyoming Association of Professional Archeologists
Wyoming Backcountry Horsemen
Wyoming Falconer's Association
Wyoming Outdoor Council
Wyoming Riparian Association
Wyoming Stock Growers Association
Wyoming Wilderness Association
Wyoming Wildlife Federation

6.4.9 Industry/Business

AECOM
Anschutz Exploration Corp.
Apex Surveying
Backcountry Horsemen of Wyoming
Bill Barrett Corporation
Bjork, Lindley, and Little PC
Brower Oil and Gas Co., Inc.
BTA Producers
Burlington Resources Oil and Gas Co.
Cameco Resources
Carousel Energy Operating LLC
Clear Creek Cattle Co.
Cluck – Cameron Cattle Co.
Conoco Phillips Company
Conservancy of the Phoenix, Inc.
CWC Outdoor Education
Dubois Frontier
Edith's Floral Shop
El Paso Production Oil and Gas Co.
EnCana Oil and Gas
EOG Resources, Inc.
Exxon Co.
Fremont County ATV
Fremont County Cattlemen's Association
High Plains Power, Inc.
Independent Petroleum Assoc. Mountain States
Inexco Oil Co.
Infinity Oil and Gas Inc.
IUOE
J.J. Brown P.G. LLC
Kennecott Uranium Company
Kinder Morgan, Inc.
Lander Valley Sportsman's Association
LJ Drilling
Louisiana Land and Exploration
Lou's Drilling
Lowham Walsh LLC
Mad Dog and the Pilgrim Booksellers

Moncrief Oil Company
Motorized Recreation Council of Wyoming
MRCON Fremont County ATV
Nance Petroleum Corporation
National Outdoor Leadership School
Orion – the Hunters Institute
PacifiCorp
Patina Oil and Gas Corporation
Petrogulf Corporation
Petroleum Association of Wyoming
PHC Reclamation, Inc.
Philp Sheep Company
Popo Agie Conservation District
Rio Tinto Energy America
Riverton Workforce Services
Rocksources Energy Corporation
Rocky Mountain Pipeline System
Rocky Mountain Power
Sell WindEnergy Inc.
Southern Wyoming Dirt Riders
Sporting Arms and Ammunition Manuf Inst
Strachan Exploration Inc.
Strathmore Minerals Corp.
Strathmore Resources
Texaco Exploration and Production
Tom Casey, Attorney at Law
Ultra Resources Inc.
UR Energy
U.S. Energy/Crested Corporation
U.S. Sportsmen's Alliance
Western Gas Resources
Western Nuclear Inc.
Wilbanks Resources Corp.
Wild Iris Mountain Sports
Wind River 4x4 Association
Wind River Consulting
Wold Oil and Gas Company
Wyoming Country Outfitters
Wyoming High Desert Outfitters
Wyoming Sportman for Fish and Wildlife
Yates Petroleum Corporation

6.4.10 Individuals

Tom Axthelm
Doug Beahn
Tom Casey
Travis Clyde
Eric Concannon
Jerry Crews
Carla and Robert Crofts
Robert C. Crofts
Alan Cross
Ron Cunningham
J. Dee Darnell
Carrie Dobey
Peter Dvorak
Liz Erickinson
John Farley
Victoria Fregoso
William S. Hancock
Scott Harnsberger
George Hartman
Paula Ellen Hinds
Floyd Krebs
Michael Kuriga
Wendell Manko
Gary Marlin
Paul McCarthy
Charlie McIntosh
Cathy Meyer
Sue Noecker
Tom Ochsuer
Michael Rohe
Joshua Scheer
Suzanne Semich
Eugene Thompson
John A. Whipp M.D.
Perry Willingham
Teddi Y. Winge

6.5 List of Preparers and Reviewers

Table 6-1 identifies BLM staff members on the EIS interdisciplinary team for the Project.

Table 6-1 BLM Interdisciplinary Team

Name	Resource
Kristin Yannone	Project Manager
Charis Tuers	Meteorology, Climatology, and Air Quality
Karina Bryan	Cultural Resources and Native American Concerns, Paleontological Resources
Tom Sunderland	Geology, Paleontological Resources, Groundwater and Surface Water Resources
Leta Rinker	Land Use
Kristin Yannone	Environmental Justice, Socioeconomics, Noise, Public Health and Safety, Hazardous Materials and Solid Waste
Jared Oakleaf	Recreation, Transportation, Visual Resources, Wilderness Characteristics
Amanda Small	Range Resources, Vegetation
Chris Krassin	Soils
Jon Kaminsky	Ground Water and Surface Water Resources
Sue Oberlie/Sarah Wempen	Wildlife and Fisheries Resources, Wild Horses
Sidney Thielke	GIS

AECOM is the third-party environmental contractor responsible for preparing the EIS under the direction of the BLM. The responsibilities and education of the individual team members are summarized in **Table 6-2**.

Table 6-2 Preparers/Reviews for AECOM and Subcontractors

AECOM Team Member	Education	Responsibility
Dan Gregory	M.S., Geology, Colorado State University B.A., Geology, Colorado College	Project Manager
Doree Dufresne	B.S., Biology/Microbiology; Minor-Chemistry, Colorado State University	Project Coordinator, Public Health and Safety
Peggy Roberts	M.S., Technical Communications (in progress), Colorado State University B.J., Journalism/Public Relation, The University of Texas of Austin	Public Outreach

Table 6-2 Preparers/Reviews for AECOM and Subcontractors

AECOM Team Member	Education	Responsibility
Vince Scheetz	M.S., Systems Management, University of Southern California B.S., Mathematics, Regis College Atmospheric Science, Colorado State University	Meteorology, Climatology, and Air Quality
Kim Munson	M.A., Anthropology, Colorado State University B.A., Anthropology, Colorado State University	Cultural Resources and Native American Concerns
Bill Berg	M.S., Geology, University of Wyoming B.S., Geology, Colorado State University	Geology, Paleontological Resources, Hazardous Materials and Solid Waste, Public Health and Safety
Steve Graber	B.S., Natural Resource Management, Colorado State University B.A., Economics, Colorado State University	Land Use, Lands With Wilderness Characteristics, Noise, Recreation, and Transportation
Erin Bergquist	M.S., Ecology, Colorado State University B.A., Environmental Studies and Economics, University of Colorado	Range Resources, Vegetation
Bernie Strom/ Planera, Inc.	MCRP (City and Regional Planning) Harvard University B.S. (Urban Planning) Iowa State University	Environmental Justice, Socioeconomics, Visual Resources
Terra Mascarenas	B.S., Soil and Crop Science, Concentration in Environmental Science, Colorado State University Certificate of Technology, Pueblo Community College	Soils
David Fetter	B.S., Watershed Science, Colorado State University	Surface Water Resources
Bob Berry	PhD, Geology/Geochemistry, Princeton University Prof Degree, Hydrogeology, Colorado School of Mines B.S., Geology, University of Hawaii	Ground Water Resources
Matt Brekke	B.S., Wildlife Biology, Minor in Fishery Biology, Colorado State University	Wildlife and Fisheries Resources
Chris Dunne	B.S., Natural Resource Management, Colorado State University	Wild Horses
Todd White	MCP, Community Planning, University of Cincinnati MEnvSc, Environmental Science, Miami University; Oxford, Ohio M.A., Anthropology, University of Colorado B.A., Geology, Miami University; Oxford, Ohio	GIS

7.0 Glossary

Alluvial fan	A fan-shaped deposit formed where a fast flowing stream flattens, slows, and spreads, typically occurring at the exit of a canyon onto a flatter plain.
Aquifer	A heterogeneous body of intercalated permeable and poorly permeable material that functions regionally as a water-yielding hydraulic unit; comprises 2 of more permeable beds separated at least locally by aquitards that impede groundwater movement.
Aquitard	A saturated, but poorly permeable, bed that impedes groundwater movement and does not yield water freely to wells.
Area of Potential Effects	Defined as “those areas in which impacts are planned or are likely to occur under Section 106 of the NHPA.”
Arkosic Sandstone	Coarse sandstone that has formed by the disintegration of granite without appreciable decomposition. It thus consists primarily of quartz and feldspar grains.
Baseline	Conditions existing prior to a specific activity.
Cairn	A man-made pile or stack of stones used as a landmark or monument.
Cambrian Period	The first geologic period of the Paleozoic Era, from 542 to 489 million years ago.
Carbonaceous	Carbon rich.
Claystone	Fine-grained rock consisting of compacted clay particles.
Confined Aquifer	An aquifer in which the water is under pressure because of an impermeable layer above it that keeps it from seeking its level.
Connected Action	Those actions that are “closely related” and “should be discussed” in the same NEPA document (40 CFR 1508.25 (a)(1)). Actions are connected if they automatically trigger other actions that may require an EIS; cannot or will not proceed unless other actions are taken previously or simultaneously; or if the actions are interdependent parts of a larger action and depend upon the larger action for their justification (40 CFR 1508.25 (a)(1)). Connected actions are limited to actions that are currently proposed (ripe for decision). Actions that are not yet proposed are not connected actions, but may need to be analyzed in cumulative effects analysis if they are reasonably foreseeable.
Cumulative Effect	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such actions (40 CFR 1508.7) and (40 CFR 1508.25).
Daughter Products	A product of radioactive decay of an element. Uranium belongs to the actinium series; daughter products in this series include uranium, actinium, and thorium.
Direct Effect	Those effects which are caused by the action and occur at the same time and place (40 CFR 1508.8[a]).
Eocene Epoch	The second epoch of the Paleogene Period in the Cenozoic Era, lasting from about 56 to 34 million years ago.
Ephemeral	Short lived.

Feldspathic Sandstone	Sandstones that contain less than 90 percent quartz, and more feldspar than unstable lithic fragments, and minor accessory minerals, and are derived from granitic-type, primary crystalline, rocks.
Flume	An open artificial water channel, in the form of a gravity chute, that leads water from a diversion dam or weir completely aside a natural flow.
Geological Epoch	A subdivision of a geological period.
Geological Period	A subdivision of a geological era.
Geometric Spreading	The spread of sound energy as a result of the expansion of the wavefronts. The sound level from a point source is reduced by 6 dB for each doubling of distance from the source.
Headcutting	A process of erosion that lengthens a drainage, stream, valley, or gulley at its head, and also enlarges its drainage basin. Water erodes the rock and soil at the head of a drainage in the opposite direction that it flows.
Historic Property	Defined in the NHPA as: "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register"; this includes artifacts, records, and remains which are related to such district, site, building, structure, or objects.
Indirect Effect	Effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on water and air and other natural systems, including ecosystems" (40 CFR 1508.8[b]).
Irretrievable Commitment of Resources	The loss of production harvest, or use of renewable resources that is not recoverable for use by future generations. These commitments may be reversible, but losses that occur during the federal action are not necessarily retrievable.
Irreversible Commitment of Resources	The loss of future options for a resource, due to primary or secondary impacts.
Key Observation Point	"One or a series of points on a travel route or at a use area or a potential use area, where the view of a management activity would be most revealing" (BLM 2007b). KOPs are commonly selected to represent the most sensitive viewpoints for a proposed management activity based on the number of peoples who would experience them or the frequency and duration of viewing.
Lithologic logs	A record of the lithology of the rock and soil encountered in a borehole from the surface to the bottom. Also known as a well log.
Lixivant	A liquid medium, either acid or base in nature, used to selectively extract target metals from an ore or mineral by assisting in rapid and complete leaching.
Mitigation	Measures or procedures which could reduce or avoid adverse impacts and have not been incorporated into the proposed action or an alternative. Mitigation can be applied to reduce or avoid adverse effects to biological, physical, or socioeconomic resources.
Mudstone	A dark sedimentary rock formed from consolidated mud and lacking the layered structure of shale.
Perennial	Occurring continuously throughout a year.

Potentiometric Surface	A hypothetical surface representing the level to which groundwater would rise if not trapped in a confined aquifer. The potentiometric surface is equivalent to the water table in an unconfined aquifer.
Precambrian	A supereon in the geologic time scale that spans from the formation of Earth around 4,600 million years ago to the beginning of the Cabrian Period, approximately 542 million years ago.
Production Well	An ISR well from which pregnant solution (lixivant with concentrated metal) is pulled.
Q/D Ratio	The ratio of emissions (Q) to distance from monitor (D) for individual sources. Used to calculate the estimated level of air quality impacts.
Quaternary Period	The most recent of the tree periods of the Cenozoic Era in the geologic time scale, spanning 2.6 million years ago to the present.
Residual Impacts	Those effects remaining after mitigation has been applied to the proposed action or an alternative.
Sandstone	Sedimentary rock consisting of sand or grains cemented together. Typically red, yellow, or brown in color.
Shale	A rock predominantly composed of clay-sized particle and characterized by parking along bedding planes.
Stream Channel	The physical confine of a stream, consisting of a bed and stream bank.
Subbasin	A subset of a subwatershed.
Subsidence	Sinking or settlement of the land surface, usually related to vertical downward movement of natural surfaces, although small-scale horizontal components may be present.
Subsoiling	A method of relieving soil compactions through fracturing compacted soils without disturbing plant life, topsoil, and surface residue. Equipment used for this process is called a subsoiler.
Subwatershed	Topographic perimeter of the catchment area of a stream tributary.
Tertiary Period	The span of geologic time stretching from 65 million to 5 million years ago.
Total Dissolved Solids	All organic and inorganic materials suspended in water that are small enough to remain in the water after filtration.
Transmissivity	A measure of the quantity of water that an aquifer can transmit horizontally.
Tuffaceous	Rock composed of compacted volcanic ash.
Unconformed Geological Layers	Formations that are separated by an erosional surface.
U_30_8	uranium oxide.
Visual Resource	The composite of basic terrain, geologic features, water features, vegetation patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for viewers.
Visual Resource Classes	“Visual resource classes are categories assigned to public lands which serve two purposes: 1) an inventory tool that portrays the relative value of the visual resources; and 2) a management tool that portrays the visual management objectives (for a particular area) (BLM 2007a). Inventory classes are assigned through the inventory process; and management classes are assigned through the Resource Management Planning (RMP) process.

Water Fence	A line of water injection wells used as a hydrologic barrier to set up a barrier - or fence - of water that prevents migration of groundwater constituents into an area beyond the water fence.
Watershed	The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.
Weir	A dam placed across a river or canal to raise or divert the water, as for a millrace, or to regulate or measure the flow.
Yellowcake	A stable uranium concentrate powder obtained from leach solutions, in an intermediate step in the processing of uranium ores.

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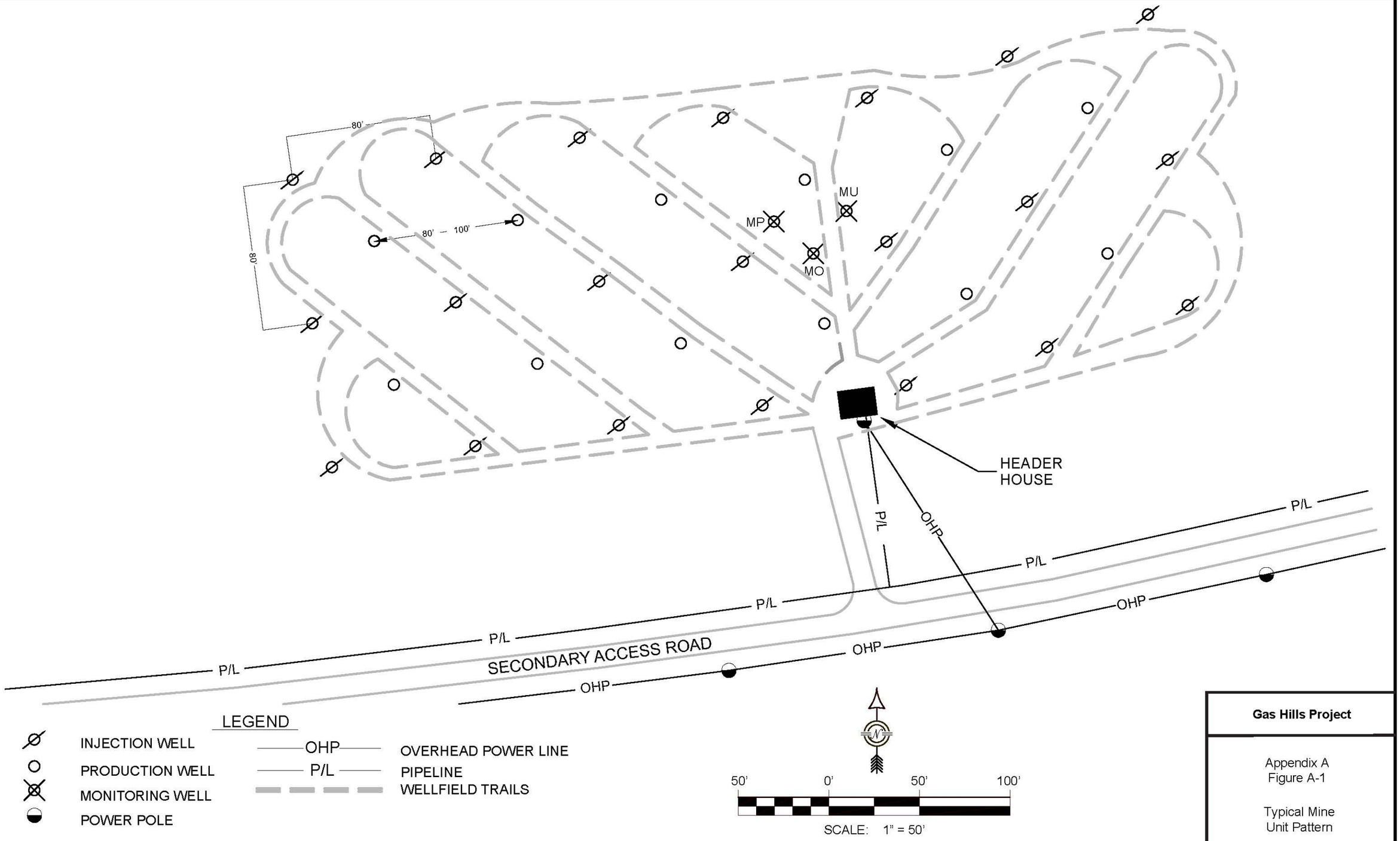
Appendix A

Typical Construction Figures



Source: PRI 2009, Figure 5.

Gas Hills Project

Appendix A
Figure A-1

Typical Mine
Unit Pattern

General Construction Requirements:

1. ALL EXCAVATION CUT SURFACES AND EMBANKMENTS SHALL BE COMPACTED TO 95% OF STANDARD PROCTOR DENSITY. PRIOR TO POND SITING THE ENGINEER SHALL DIRECT A SUBSURFACE INVESTIGATION PROGRAM TO IDENTIFY DEPTH TO CONSOLIDATED ROCK AND/OR COLLECT SAMPLES AND MEASUREMENTS TO DETERMINE CONSOLIDATION OF SUBSTRATE. UNSUITABLE CONDITIONS MAY RESULT IN THE RELOCATION OF THE POND.
2. GRANULAR BEDDING MATERIAL SHALL BE COMPACTED TO 90% OF STANDARD PROCTOR DENSITY.
3. SECONDARY LINER SHALL BE CONSTRUCTED OF NATIVE SOILS OR A SYNTHETIC LINER.
4. AN AUTOMATIC SUMP PUMP SHALL BE INSTALLED IN THE INSPECTION MANHOLE WITH A FLOAT SWITCH AND DISCHARGE PIPE BACK INTO THE EVAPORATION POND.
5. INFLUENT PIPES SHALL BE PLACED SUCH THAT THE PIPE INVERT IS AT LEAST SIX INCHES ABOVE THE MAXIMUM OPERATING LEVEL OF THE POND.
6. A VENTED CLEANOUT SHALL BE INSTALLED PRIOR TO THE ENTRANCE OF THE INFLUENT PIPE INTO THE PONDS, LOCATED CLOSE TO THE POND EMBANKMENT.
7. ALL EMBANKMENTS AND DISTURBED AREAS WHICH ARE NOT BELOW THE INTERNAL OPERATING LEVEL OF THE PONDS SHALL BE SEEDED WITH DRYLAND GRASSES TO PREVENT EROSION.
8. PERIMETER FENCES SHALL BE INSTALLED AROUND ALL PONDS, CAPABLE OF KEEPING LIVESTOCK AND WILDLIFE FROM ENTERING THE AREAS (NOT SHOWN).

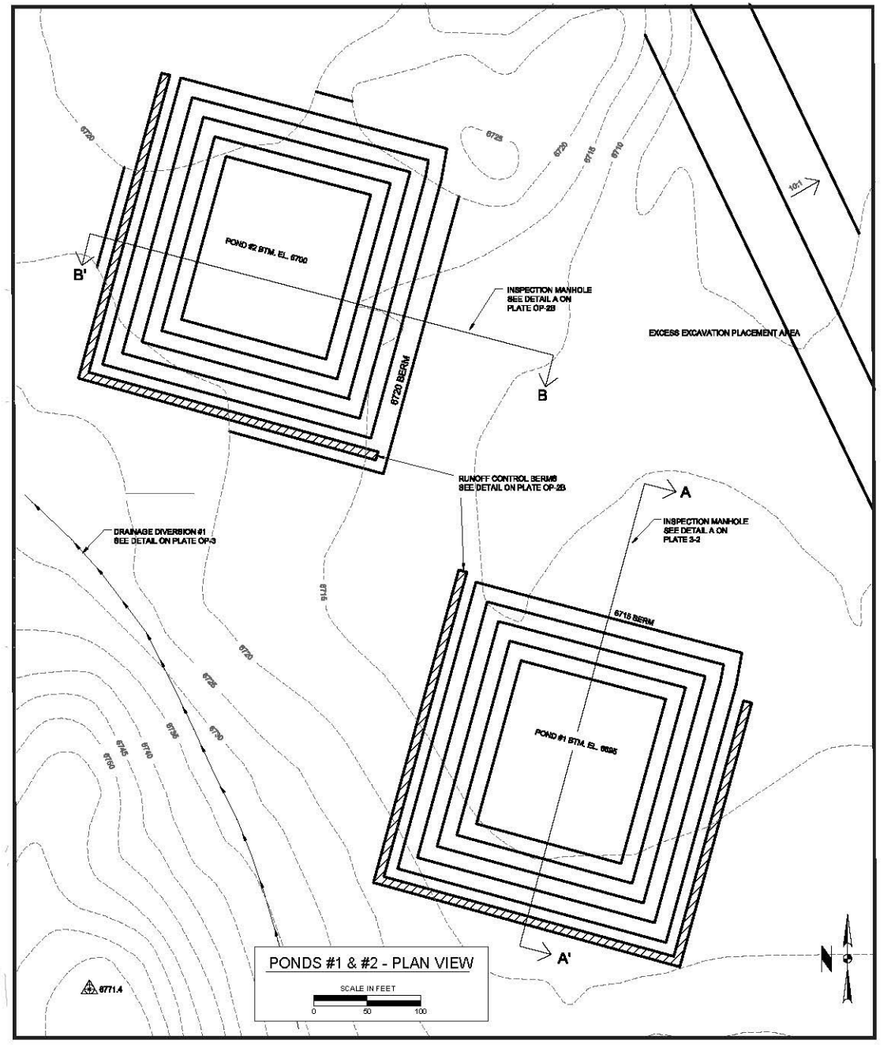
CONSTRUCTION INSPECTION AND QUALITY CONTROL:

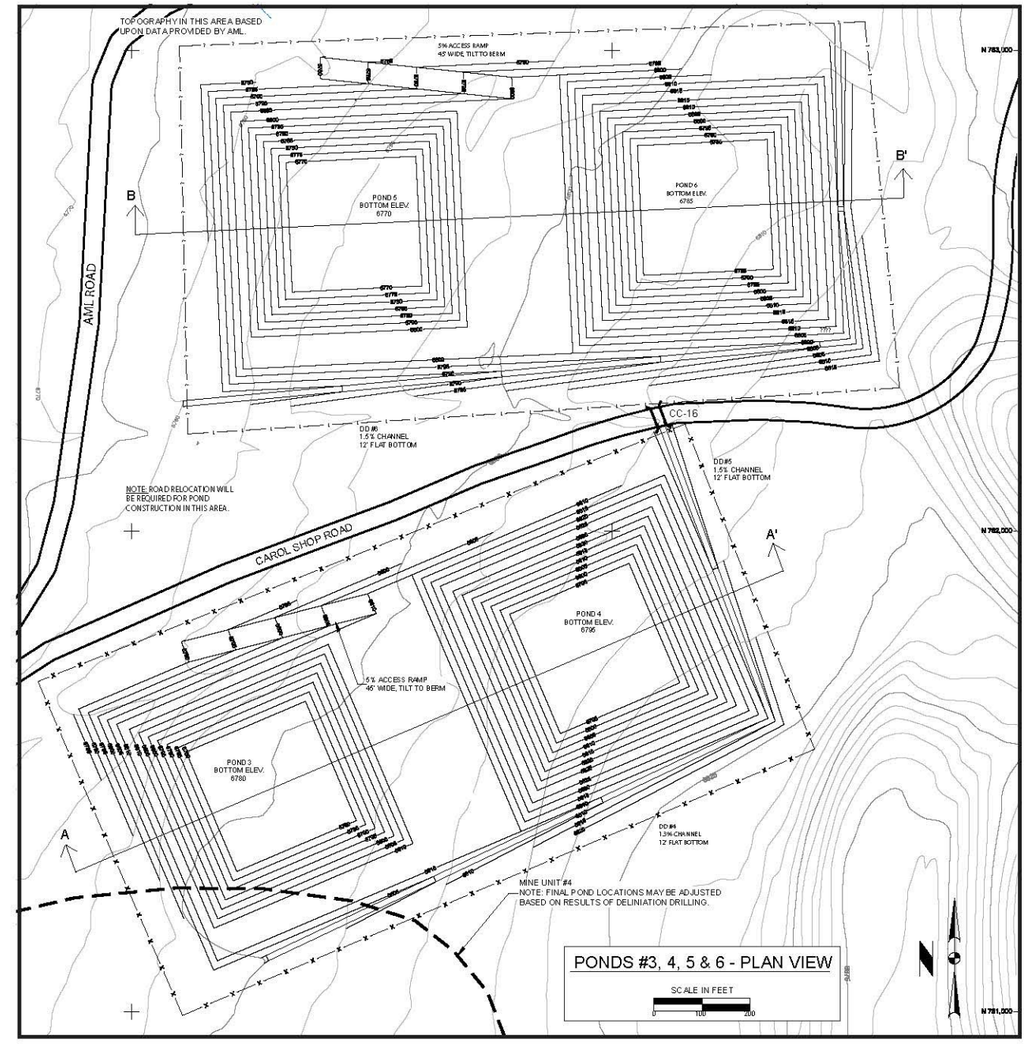
1. DURING CONSTRUCTION, SIDE INSPECTION AND QUALITY CONTROL TESTING SHALL BE COMPLETED UNDER THE DIRECTION OF A PROFESSIONAL ENGINEER DULY REGISTERED IN THE STATE OF WYOMING AND EXPERIENCED IN SIMILAR CONSTRUCTION REQUIREMENTS AND/OR METHODS.

PERFORATED PIPE SHALL MEET OR EXCEED THE FOLLOWING SPECIFICATIONS:

1. NOMINAL INSIDE DIAMETER 4 INCHES.
2. PIPE STIFFNESS RATING 50 PSI.
3. PIPE WORKING PRESSURE RATING WILL BE 160 PSI OR BETTER AND THE CONVEYANCE PIPE WILL BE HDPE PE 3408 OR BETTER.
4. WATER INLET AREA 2.95 SQUARE INCHES PER LINEAR FOOT.
5. MAXIMUM PERFORATION DIMENSIONS (MANUFACTURER); DRILLED HOLE DIAMETER 3/6 INCH; SLOTTED HOLES WIDTH 1/8 INCH (3.18 MM), LENGTH 7/8 INCH (22.2MM).
6. COMPLETELY ENCASED IN GEOTEXTILE FABRIC.

SITE LOCATION: PONDS 1 AND 2 ARE LOCATED IN FREMONT COUNTY; NW1/4, SECTION 28, T33N, R89W. PONDS 3, 4, 5, AND 6 ARE LOCATED IN FREMONT COUNTY; NE4/1, SECTION 28, T33N, R89W.





CONVEYANCE PIPE SHALL MEET OR EXCEED THE FOLLOWING SPECIFICATIONS:

1. NOMINAL INSIDE DIAMETER 4 INCHES.
2. PIPE STIFFNESS RATING 50 PSI.
3. HDPE OR SDR 35 PIPE.
4. WATER TIGHT CONNECTIONS.

PRIMARY LINERS SHALL MEET OR EXCEED THE FOLLOWING SPECIFICATIONS:

1. NOMINAL THICKNESS (GAUGE) SHALL BE AT LEAST 60 MIL (1.5 MM).
2. MINIMUM TENSILE STRENGTH AT BREAK SHALL BE AT LEAST 240 LBS.
3. MINIMUM PUNCTURE RESISTANCE SHALL BE AT LEAST 270 LBS.
4. LINER INSTALLATION, INCLUDING PERFORMANCE AND INSPECTION, SHALL MEET OR EXCEED THE LINER MANUFACTURER'S RECOMMENDATIONS, AND CURRENT APPLICABLE ASTM STANDARDS.
5. LINEAR DESIGN IS PRELIMINARY AND THE FINAL DESIGN MAY CHANGE. THE POND LINER SYSTEM WILL CONFORM TO THE CRITERIA OUTLINED IN THE CFR'S.
6. SECTION 3.5.6 OF THE OPERATIONS PLAN PRESNTS SPECIFICATION SOF GRANULAR MATERIALS ABOVE, BELOW, AND BETWEEN LINERS. IN SUMMARY, GRANULAR BACKFILL SHALL CONSIST OF ROUNDED SAND OR GRAVEL 100% PASSING ¾ INCH SIEVE AND NO MORE THAN 10% ASSING THE #200 SIEVE AND HAVING A HYDRAULIC CONDUCTIVITY OF 10-1 CM/SEC.

Source: PRI 2009, Plates OP7-2A.

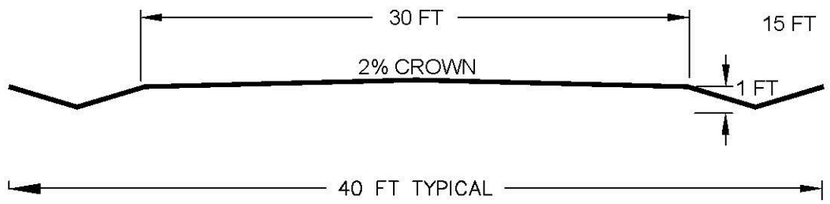
Gas Hills Project

Appendix A
Figure A-2

Evaporation Pond Design

MAIN ACCESS ROADS

TYPICAL CROSS SECTION



DITCH SLOPES 3:1 OR FLATTER
SLOPE VARIES TO MATCH TOPOGRAPHY
TYPICAL ROW 60 FT

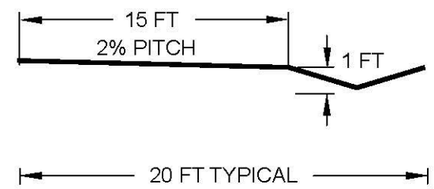
ROAD DESIGN CRITERIA

DESIGN USE	TWO-WAY TRAFFIC, INCLUDING HEAVY TRUCK TRAFFIC.
MAXIMUM SPEED	40 MPH MAXIMUM, REDUCE SPEEDS FOR AREAS OF LIMITED VISIBILITY AND ROAD JUNCTIONS.
MAXIMUM GRADE	8% FOR NO MORE THAN 2,000 FEET; 6% OVERALL FOR NORMAL TERRAIN CONDITIONS.
ROADWAY WIDTH	30 FOOT RUNNING SURFACE WITHIN 60 FOOT ROW.
MINIMUM PITCH	2% FROM CENTERLINE.
MINIMUM CURVE	MINIMUM CURVE RADIUS 500 FEET WITH A 5 DEGREE CENTRAL ANGLE.
ROAD DITCH	MINIMUM 1 FOOT DEPTH, 3:1 (H; v) SIDE SLOPES, AT 2 TO 4% GRADES, VARY TO MATCH TOPO.
CULVERT DESIGN	25 YEAR DESIGN, MINIMUM SIZE 18 INCHES.
SURFACING	NO SURFACING FOR SP, SW, GC, GM, GP, GW - ALL OTHERS SOILS 4 INCHES GRAVEL SURFACING.
MAINTENANCE	GRADING TO MAINTAIN CROWN, DITCHING, AND SURFACING.

NOT TO SCALE

SECONDARY ACCESS ROADS

TYPICAL CROSS SECTION



DITCH SLOPES 3:1 OR FLATTER
SLOPE VARIES TO MATCH TOPOGRAPHY
TYPICAL ROW 40 FT

ROAD DESIGN CRITERIA

DESIGN USE	ONE-WAY TRAFFIC, INCLUDING LIGHT TRUCK TRAFFIC.
MAXIMUM SPEED	30 MPH MAXIMUM, REDUCE SPEEDS FOR AREAS OF LIMITED VISIBILITY AND ROAD JUNCTIONS.
MAXIMUM GRADE	8% OVERALL FOR NORMAL TERRAIN CONDITIONS.
ROADWAY WIDTH	15 FOOT RUNNING SURFACE WITHIN 40 FOOT ROW; TURNOUTS EVERY 1,000 FT.
MINIMUM PITCH	2% FROM UPHIL SIDE OF ROAD.
MINIMUM CURVE	MINIMUM CURVE RADIUS 200 FEET.
ROAD DITCH	MINIMUM 1 FOOT DEPTH, 3:1 (h: v) SIDE SLOPES, AT 2 TO 4% GRADES, VARY TO MATCH TOPO.
CULVERT DESIGN	10 YEAR DESIGN, MINIMUM SIZE 18 INCHES.
SURFACING	NO SURFACING MOST AREAS; REQUIRED ONLY IN AREAS OF POOR DRAINAGE AND SOILS.
MAINTENANCE	GRADING TO MAINTAIN PITCH, DITCHING, AND SURFACE.

NOT TO SCALE

NOTES

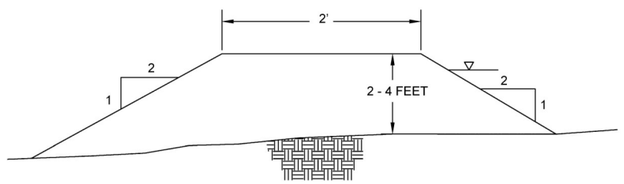
1. MAIN ACCESS ROADS WILL BE ESTABLISHED AND MAINTAINED FROM THE GAS HILLS ROAD TO ALL SATELLITE FACILITIES.
2. SECONDARY ACCESS ROADS WILL BE ESTABLISHED AND MAINTAINED IN ALL ACTIVE WELL FIELDS.
3. TO THE EXTENT PRACTICAL,ALL PIPELINES AND UTILITIES WILL BE LOCATED WITHIN THE MAIN AND SECONDARY ACCESS ROAD ROW.
4. WHERE REQUIRED, GRAVEL SURFACING SHALL BE 3 INCH MINUS PIT RUN OF THE FOLLOWING SOIL TYPES; SW, SP, GP, GW.
5. WATERING FOR DUST CONTROL WILL BE USED AS NECESSARY.
6. WATER USED FOR DUST CONTROL SHALL BE FROM AN APPROVED AND PERMITTED SOURCE.
7. ROAD SIGNAGE SHALL MEET UNIFORM TRAFFIC CONTROL STANDARDS INCLUDING SIGNAGE FOR SPEED LIMIT, EQUIPMENT CROSSING, AND STOP AND/OR YIELD AT ALL INTERSECTIONS.
8. TOPSOIL DISTURBED ALONG THE MAIN ACCESS ROAD WILL BE STRIPPED AND STOCKPILED FOR FUTURE RECLAMATION IN A MANNER WHICH PROTECTS THE TOPSOIL RESOURCE FROM CONTAMINATION AND/OR EROSION.
9. TOPSOIL ALONG SECONDARY ACCESS ROADS (WITHIN WELL FIELD AREAS) WILL BE STRIPPED TO AN AVERAGE DEPTH OF 6 INCHES UNLESS SOILS HAVE BEEN DEMONSTRATED TO BE UNSUITABLE AS A PLANT GROWTH MEDIUM SALVAGED TOPSOIL WILL BE STOCKPILED IN A MANNER WHICH PROTECTS THE TOPSOIL RESOURCE FROM CONTAMINATION AND/OR EROSION UNTIL USED FOR FINAL RECLAMATION.
10. WHERE POSSIBLE UTILITIES INCLUDING POWER LINES AND PIPELINES WILL BE LOCATED WITHIN THE ROW ON EITHER SIDE OF THE MAIN AND SECONDARY ACCESS ROADS.

Gas Hills Project

Appendix A
Figure A-3

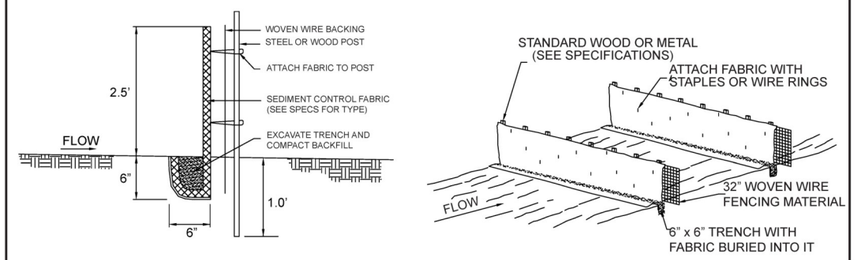
Typical Road Construction

Source: PRI 2009, Plate OP-4.



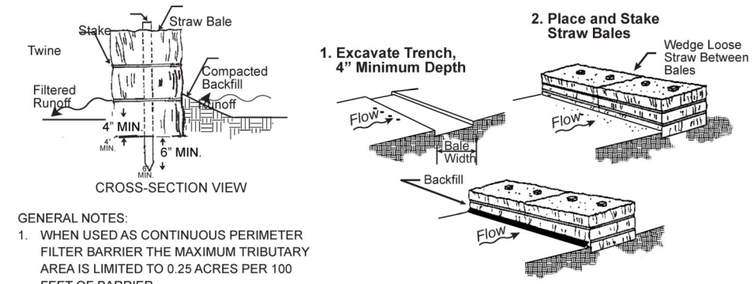
TYPICAL BERM CROSS SECTION

NOT TO SCALE



SEDIMENT CONTROL FENCE DETAIL

NOT TO SCALE



GENERAL NOTES:

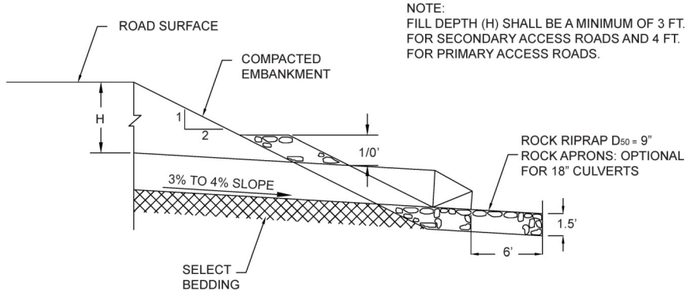
1. WHEN USED AS CONTINUOUS PERIMETER FILTER BARRIER THE MAXIMUM TRIBUTARY AREA IS LIMITED TO 0.25 ACRES PER 100 FEET OF BARRIER
2. INSPECT, REPAIR, AND REPLACE (IF NECESSARY) THE FILTERS AFTER EACH STORM EVENT.

TYPICAL STRAW BALE DIKE

NOT TO SCALE

18' TO 30" DIA. CULVERT DETAILS

NOTE:
FILL DEPTH (H) SHALL BE A MINIMUM OF 3 FT. FOR SECONDARY ACCESS ROADS AND 4 FT. FOR PRIMARY ACCESS ROADS.

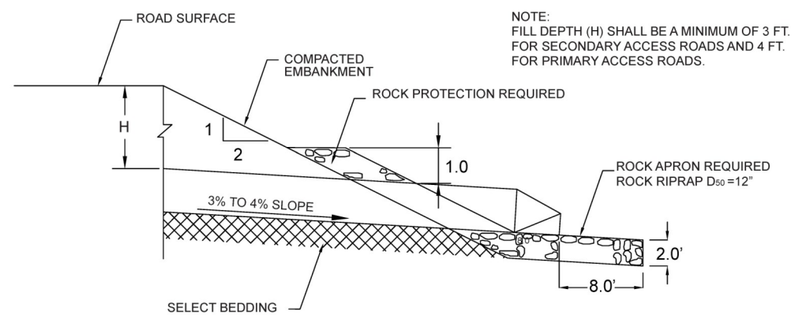


CULVERT OUTLET PROFILE DETAIL

NOT TO SCALE

36" TO 48" DIA. CULVERT DETAILS

NOTE:
FILL DEPTH (H) SHALL BE A MINIMUM OF 3 FT. FOR SECONDARY ACCESS ROADS AND 4 FT. FOR PRIMARY ACCESS ROADS.



CULVERT OUTLET PROFILE DETAIL

NOT TO SCALE

NOTES

GENERAL CONSTRUCTION REQUIREMENTS:

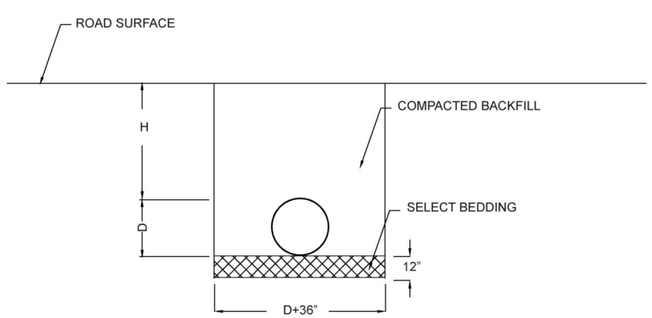
1. ALL EXCAVATION CUT SURFACES, EMBANKMENTS, AND TRENCH BACKFILL MATERIALS SHALL BE COMPACTED TO 90% STANDARD PROCTOR DENSITY.
2. SELECT BEDDING MATERIAL SHALL BE COMPACTED TO 90% OF STANDARD PROCTOR DENSITY.
3. SELECT BEDDING MATERIAL SHALL CONSIST OF SELECTIVELY HANDLED SANDS AND GRAVELS OR AN EQUIVALENT SOIL MATERIAL WITH NO PARTICLES GREATER THAN 1-INCH, AT OPTIMUM MOISTURE CONTENT FOR COMPACTION.
4. WHERE WET AND UNSTABLE SOIL INCAPABLE OF SUPPORTING THE CULVERT IS ENCOUNTERED, SUCH MATERIAL SHALL BE REMOVED, AND REPLACED WITH SELECT BEDDING MATERIAL.
5. TRENCH BACKFILL SHALL CONSIST OF SELECTED EXCAVATION OR BORROW MATERIALS WITH NO LARGE ROCKS, AND AT OPTIMUM MOISTURE CONTENT FOR COMPACTION.
6. TRENCH BACKFILL SHALL BE PLACED IN LIFTS NOT EXCEEDING 6" IN COMPACTED DEPTH, AND BROUGHT UP EVENLY ON BOTH SIDES OF THE CULVERT FOR ITS FULL LENGTH.
7. ROCK PROTECTION AND ROCK APRONS SHALL CONSIST OF WELL-GRADED DURABLE MATERIALS WITH A D50 DIAMETER OF 9" OR 12" AS SHOWN ON THE PLANS.
8. METAL OR PLASTIC CULVERT END SECTIONS, CONSISTING OF THE SAME MATERIAL TYPE AS THE ATTACHED CULVERT, WILL BE INSTALLED ON THE CULVERT INLETS AND OUTLETS.

CORRUGATED STEEL PIPE AND END SECTIONS SHALL MEET THE FOLLOWING SPECIFICATIONS:

1. CONFORM TO THE APPLICABLE SECTIONS OF AASHTO M 36 AND EITHER AASHTO M 218 OR AASHTO M 274 FOR THE SPECIFIED SECTIONAL DIMENSIONS AND THICKNESS.
2. THE SHEET THICKNESS OF THE STEEL PIPE SHALL BE A MINIMUM OF 14 GAGE.
3. CORRUGATED STEEL PIPE MAY BE USED FOR ALL SIZES OF CULVERTS.

CORRUGATED POLYETHYLENE PIPE AND END SECTIONS SHALL MEET THE FOLLOWING SPECIFICATIONS:

1. CONFORM TO THE APPLICABLE SECTIONS OF AASHTO M 294-92 FOR THE SPECIFIED SECTIONAL DIMENSIONS AND THICKNESS.
2. CORRUGATED POLYETHYLENE PIPE MAY BE USED FOR CULVERT SIZES 18", 24" AND 36" ONLY FOR CULVERTS GREATER THAN 36", STEEL SHALL BE USED.



CULVERT TYPICAL CROSS SECTION

NOT TO SCALE

CULVERT SIZING TABLE

CULVERT DIAMETER (IN)	MINIMUM FILL (FT)	CULVERT CAPACITY (CFS)
PRIMARY ACCESS ROADS		
18	4	18
24	4	35
30	4	60
36	4	92
42	4	130
48	4	176
SECONDARY ACCESS ROADS		
18	3	16
24	3	32
30	3	55
36	3	82

Source: PRI 2009, Plate OP-5.

Gas Hills Project

Appendix A
Figure A-4

Typical Culvert Installation

Appendix B

PFYC System

U.S. DEPARTMENT OF THE INTERIOR **BUREAU OF LAND MANAGEMENT**
National

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
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EMS TRANSMISSION 10/18/2007
Instruction Memorandum No. 2008-009
Expires: 09/30/2009

To: All State Directors
From: Assistant Director, Renewable Resources and Planning
Subject: Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands

Program Areas: Paleontological Resources Management, Resource Management Planning, Lands and Realty Management, Minerals Management, Range

Purpose: This Instruction Memorandum (IM) transmits the Bureau of Land Management (BLM) classification system for paleontological resources on public lands. The classification system is based on the potential for the occurrence of significant paleontological resources in a geologic unit, and the associated risk for impacts to the resource based on Federal management actions. Copies of the classification system and implementation guidance are attached.
Policy/Action: The Potential Fossil Yield Classification (PFYC) system will be used to classify paleontological resource potential on public lands in order to assess possible resource impacts and mitigation needs for Federal actions involving surface disturbance, land tenure adjustments, and land-use planning. Implementation of the PFYC system will not mandate changes to existing land use plans, project plans, or other completed efforts. Integration into plans presently being developed is discretionary. All efforts subsequent to issuance of this IM should incorporate the PFYC system. This system will replace the current Condition Classification in the Handbook (H-8270-1) for Paleontological Resource Management.
Timeframe: This guidance is effective immediately for all BLM offices.
Background: This classification system for paleontological resources is intended to provide a more uniform tool to assess potential occurrences of paleontological resources and evaluate possible impacts. It uses geologic units as base data, which is more readily available to all users. It is intended to be applied in broad approach for planning efforts, and as an intermediate step in evaluating specific projects. This is part of a larger effort to update the Handbook H-8270-1 (General Procedural Guidance for Paleontological Resource Management) Chapter III (Assessment & Mitigation) and Chapter II.A.2 and will be incorporated into that Handbook update.
Impact on Budget: Costs for the initial classification of geologic units for those States that have not already determined the classification will be borne by each Office. Implementation of the PFYC system will have no additional costs.
Manual/Handbook Affected: Supersedes H-8270-1 (General Procedural Guidance for Paleontological Resource Management) Chapter II.A.2.
Coordination: The classification system is the product of the BLM's regional paleontologists, other BLM employees, and outside reviewers. This system is very similar to the Forest Service's Fossil Yield Potential Classification and will enable closer coordination of paleontological resource management between the agencies.

Contact: For questions regarding application of this policy and guidance, please contact Lucia Kuizon, National Paleontologist, at (202) 452-5107 or lkuizon@blm.gov.

Signed by:
Todd S. Chirstensen

Authenticated by:
Robert M. Williams

Acting, Deputy Assistant Director
Renewable Resources and Planning

Division of IRM Governance

2 Attachments:
1 – The Potential Fossil Yield Classification (PFYC) System (4 pp)
2 – Guidance for Implementing the PFYC System (5 pp)

Potential Fossil Yield Classification (PFYC) System.

Occurrences of paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

Using the Potential Fossil Yield Classification (PFYC) system, geologic units are classified based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher class number indicating a higher potential. This classification is applied to the geologic formation, member, or other distinguishable unit, preferably at the most detailed mappable level. It is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment.

The PFYC system is meant to provide baseline guidance for predicting, assessing, and mitigating paleontological resources. The classification should be considered at an intermediate point in the analysis, and should be used to assist in determining the need for further mitigation assessment or actions.

The descriptions for the classes below are written to serve as guidelines rather than as strict definitions. Knowledge of the geology and the paleontological potential for individual units or preservational conditions should be considered when determining the appropriate class assignment. Assignments are best made by collaboration between land managers and knowledgeable researchers.

Class 1 – **Very Low**. Geologic units that are not likely to contain recognizable fossil remains.

- Units that are igneous or metamorphic, excluding reworked volcanic ash units.
- Units that are Precambrian in age or older.

(1) Management concern for paleontological resources in Class 1 units is usually negligible or not applicable.

(2) Assessment or mitigation is usually unnecessary except in very rare or isolated circumstances.

The probability for impacting any fossils is negligible. Assessment or mitigation of paleontological resources is usually unnecessary. The occurrence of significant fossils is non-existent or extremely rare.

Class 2 – **Low**. Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils.

- Vertebrate or significant invertebrate or plant fossils not present or very rare.
- Units that are generally younger than 10,000 years before present.
- Recent aeolian deposits.
- Sediments that exhibit significant physical and chemical changes (i.e., diagenetic alteration).

(1) Management concern for paleontological resources is generally low.

(2) Assessment or mitigation is usually unnecessary except in rare or isolated circumstances.

The probability for impacting vertebrate fossils or scientifically significant invertebrate or plant fossils is low. Assessment or mitigation of paleontological resources is not likely to be necessary. Localities containing important resources may exist, but would be rare and would not influence the classification. These important localities would be managed on a case-by-case basis.

Class 3 – **Moderate** or **Unknown**. Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential.

- Often marine in origin with sporadic known occurrences of vertebrate fossils.
- Vertebrate fossils and scientifically significant invertebrate or plant fossils known to occur intermittently; predictability known to be low.

  (or)
- Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.

Class 3a – **Moderate Potential.** Units are known to contain vertebrate fossils or scientifically significant nonvertebrate fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.

Class 3b – **Unknown Potential.** Units exhibit geologic features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or the area is known. This may indicate the unit or area is poorly studied, and field surveys may uncover significant finds. The units in this Class may eventually be placed in another Class when sufficient survey and research is performed. The unknown potential of the units in this Class should be carefully considered when developing any mitigation or management actions.

(1) Management concern for paleontological resources is moderate; or cannot be determined from existing data.

(2) Surface-disturbing activities may require field assessment to determine appropriate course of action.

This classification includes a broad range of paleontological potential. It includes geologic units of unknown potential, as well as units of moderate or infrequent occurrence of significant fossils. Management considerations cover a broad range of options as well, and could include pre-disturbance surveys, monitoring, or avoidance. Surface-disturbing activities will require sufficient assessment to determine whether significant paleontological resources occur in the area of a proposed action, and whether the action could affect the paleontological resources. These units may contain areas that would be appropriate to designate as hobby collection areas due to the higher occurrence of common fossils and a lower concern about affecting significant paleontological resources.

Class 4 – **High**. Geologic units containing a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability. Surface disturbing activities may adversely affect paleontological resources in many cases.

Class 4a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two acres. Paleontological resources may be susceptible to adverse impacts from surface disturbing actions. Illegal collecting activities may impact some areas.

Class 4b – These are areas underlain by geologic units with high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

(1) Management concern for paleontological resources in Class 4 is moderate to high, depending on the proposed action.

(2) A field survey by a qualified paleontologist is often needed to assess local conditions.

(3) Management prescriptions for resource preservation and conservation through controlled access or special management designation should be considered.

(4) Class 4 and Class 5 units may be combined as Class 5 for broad applications, such as planning efforts or preliminary assessments, when geologic mapping at an appropriate scale is not available. Resource assessment, mitigation, and other management considerations are similar at this level of analysis, and impacts and alternatives can be addressed at a level appropriate to the application.

The probability for impacting significant paleontological resources is moderate to high, and is dependent on the proposed action. Mitigation considerations must include assessment of the disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access resulting in greater looting potential. If impacts to significant fossils can be anticipated, on-the-ground surveys prior to authorizing the surface disturbing action will usually be necessary. On-site monitoring or spot-checking may be necessary during construction activities.

Class 5 – **Very High**. Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation.

Class 5a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two contiguous acres. Paleontological resources are highly susceptible to adverse impacts from surface disturbing actions. Unit is frequently the focus of illegal collecting activities.

Class 5b – These are areas underlain by geologic units with very high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has very high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

(1) Management concern for paleontological resources in Class 5 areas is high to very high.

(2) A field survey by a qualified paleontologist is usually necessary prior to surface disturbing activities or land tenure adjustments. Mitigation will often be necessary before and/or during these actions.

(3) Official designation of areas of avoidance, special interest, and concern may be appropriate.

The probability for impacting significant fossils is high. Vertebrate fossils or scientifically significant invertebrate fossils are known or can reasonably be expected to occur in the impacted area. On-the-ground surveys prior to authorizing any surface disturbing activities will usually be necessary. On-site monitoring may be necessary during construction activities.

Guidance for implementing the Potential Fossil Yield Classification (PFYC) System

Introduction

The Potential Fossil Yield Classification (PFYC) system will aid in assessing the potential for discovery of significant paleontological resources or the impact of surface disturbing activities to these resources.

It is intended to assist in determining proper mitigation approaches for surface disturbing activities, disposal or acquisition actions, recreation possibilities or limitations, and other BLM-approved activities. It will provide consistent information for input and analysis during planning efforts. The PFYC system can also highlight the areas most likely to be a focus of paleontological research efforts or illegal collecting. It is hoped that this system will allow BLM to direct management efforts toward potentially significant areas and reduce efforts in areas of lower potential.

This classification system was originally developed by the Forest Service's Paleontology Center of Excellence and the Region 2 (FS) Paleontology Initiative in 1996. Modifications were made by the BLM's Paleontological Resources staff in subsequent years.

Paleontological resources are closely associated with the geologic rock units containing them; that is, fossils are found more frequently in some rock units than others. The management of paleontological resources can thus be tied to the geologic units present at or near the ground surface, with greater management emphasis aimed at higher potential geologic units.

Uses

This PFYC system is utilized for land use planning efforts and for the preliminary assessment of potential impacts and proper mitigation needs for specific projects. It is intended to provide a tool to assess potential occurrences of significant paleontological resources. It is meant to be applied in broad approach for planning efforts, and as an intermediate step in evaluating specific projects.

There are five Classes with Class 1 being Very Low Potential and Class 5 being Very High Potential. Although granite, lava beds, and other igneous or metamorphic rock types are usually considered to be void of any fossils, outcrops of these rocks may have fissure fillings, cave-like structures, sinkholes, and other features that may preserve significant paleontological resources or information, so the potential is not zero; therefore Class 1 is applied to these rock types usually considered not to contain fossil resources.

It is intended that this system replace the current Condition Classification in the Handbook (H-8270-1), for Paleontological Resource Management. In general, the following is a comparison of the Condition Classification rankings to the new PFYC Classes:

Condition (from H-8270-1)	PFYC Class (this Instruction Memorandum)
Condition 1 – Areas known to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. (Note: this refers to known localities or groups of localities)	PFYC Class 4 (High) or Class 5 (Very High), based on geologic unit.
Condition 2 – Areas with exposures of geological units or settings that have high potential to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils.	PFYC Class 3 (Moderate), Class 4 (High), or Class 5 (Very High), based on geologic unit.
Condition 3 – Areas that are very unlikely to produce vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils.	PFYC Class 1 (Very Low) or Class 2 (Low).

Assignment of Classes

A separate class ranking is assigned to each recognized geologic formation or member present at the surface. Deposits of young alluvium (post-Pleistocene) or thick soils can often be ignored. However, geologic mapping may not separate the older Pleistocene alluvium which, may contain significant vertebrate fossils, and thus these units need to be carefully considered. Available geologic mapping, depending on map scale, may combine multiple formations or units. In these cases, the assigned classification should use the highest class of those included units. For ease of application, the classifications should be integrated into a Geographic Information System (GIS) based geologic map.

The classification is initially determined by the Regional Paleontologist; the State Office Paleontology Lead in collaboration with the Regional Paleontologist; or by knowledgeable individuals from a paleontology museum, university paleontology department, or consulting firm working under a formal agreement. Several States have already completed an initial classification and are incorporating the system into new planning and mitigation efforts.

To maintain consistency in planning efforts, mitigation requirements, and other management approaches, the classification should be applied to each formation on a state-wide basis, and even across State boundaries. But in some situations, geologic characteristics within formations may change across the State or region and may alter the potential for fossil occurrence. These differences may be a characteristic of the formation, be variable in occurrence, and unmappable at a workable scale; or may indicate a regional gradient, where a formation is highly fossiliferous in one portion of the State, but has lowered potential in another area. A variable occurrence in potential may be included in the general information about the formation. A regional gradient can be addressed by assigning a different class for separate areas.

Multiple class assignments for an individual formation should be applied in consultation with the State Office to maintain consistency across Field Office boundaries.

Over time, additional information may be acquired or developed that may suggest that a change in the class assignment is appropriate, especially from the Unknown Class (3b) to a higher or lower class. The classification should reflect the most current information, and recent research or discoveries may indicate a change is warranted. However, any changes should be measured against existing applications or use of the current classification, such as usage in Resource Management Plans (RMPs) or other planning or management documents.

Application

In planning documents and other general applications, these classes allow for uniform discussion of the paleontologic resource, potential adverse impacts, and management approaches. Assessment of general conditions, such as acres or percentages of each class, or spatial identification of important areas can be determined and presented in simple manner. Identification of areas of potential concern with other resources can be identified using GIS mapping or explained in the text body in simple fashion.

The PFYC classes may also be utilized to assess the possibility of adverse or beneficial impacts from land tenure adjustment (disposal or acquisition) proposals prior to on-the-ground surveys.

A primary purpose of the PFYC is to assess the possible impacts from surface disturbing activities and help determine the need for pre-disturbance surveys and monitoring during construction. This assessment should be an intermediate step in the analysis process; and local conditions such as amount of exposed bedrock should be considered when final mitigation needs are determined. The determination should also be supplemented by occurrences of known fossil localities and local geologic and topographic knowledge.

Mitigation Needs Assessment

Impacts of most surface-disturbing activities, and the need for mitigation efforts, are addressed by the local Field Office. Some larger actions, such as major pipeline projects, may be handled by the State Office, or even as multi-State projects. In all these cases, the assessment of impacts to paleontological resources and need for mitigation can be addressed in similar fashion through a progression of steps. The following outlines the general steps used to apply the PFYC system to this mitigation process.

1. **Identify the proposed action and affected area.** Consider the area directly impacted by the action, as well as areas that may be impacted by vehicle drive ways, equipment parking, storage areas, and increased access. Also consider the depth of disturbance to determine possible subsurface impacts.

2. Identify the potential impacts to paleontological resources. Determine the geologic units that may be impacted and the associated PFYC classes, and consult other sources of information about known localities or paleontological research that may have been done previously.

Based on the PFYC class and any additional resource information, determine the probability of impacting significant paleontological resources. If known localities are in the area of possible impact, determine if those localities can be avoided by altering the proposed action, such as repositioning a well pad location or rerouting a pipeline around a locality.

3. Determine the need for field survey or other mitigation efforts. On-the-ground field surveys, on-site monitoring, spot-checking at key times during construction, or locality avoidance are all possible mitigation approaches to lessen adverse impacts.

- If the PFYC class for the impacted area is Class 1 or 2, and there are no known localities within the area, no further assessment is typically needed.
- If a Class 3a (Moderate Potential) unit underlies the area, the local geologic conditions should be considered, as well as any known localities in the region. It may be necessary to consult with the Regional Paleontologist or other qualified paleontologist to assess the local conditions.
- If a Class 3b (Unknown Potential) unit underlies the area, it may be appropriate to require an on-site preliminary assessment by a qualified paleontologist.
- If the area is a Class 4b (buried bedrock with High Potential) or Class 5b (buried bedrock with Very High Potential), an assessment of the possible impacts to bedrock units must be made. If the proposed action will not penetrate the protective soil or alluvial layer, a pre-work survey or monitoring during the activity may not be necessary. If the potential exists to remove the protective layer and impact the bedrock unit below, it may be prudent to require a pre-work field survey and/or on-site monitoring during disturbance or spot-checks at key times. Because the bedrock unit is typically buried for much of the area in question, a pre-work survey may not always be necessary, as the fossil material may not be visible. However, it may then be more important to have an on-site monitor during disturbance or spot-checks at key times.
- If it is a Class 4a (exposed bedrock with High Potential) or Class 5a (exposed bedrock with Very High Potential) area, it will be necessary in most (Class 4a) or almost all (Class 5a) situations to require a pre-activity field survey of the areas directly and indirectly impacted.

Larger projects may impact multiple geologic units with differing PFYC Classes. In those cases, field survey and monitoring may be applied at differing levels. For example, surveys may be appropriate only on the Class 4 and 5 formations and not the Class 2 formations along a pipeline project. Careful mapping and detailed field notes should reflect the differing survey/monitoring intensities, and should be included in the consultant's report to BLM.

4. Conduct Pre-work Field Survey. Field surveys are almost always needed for Class 4 and 5 units, especially exposed bedrock areas (Class 4a and 5a). Class 3 units may or may not require a survey. Local conditions, such as vegetated areas or pockets of bedrock exposure, may affect the need and intensity of field surveys.

The consultant is required to submit a report of findings after completion of the field survey. In addition to standard reporting information, the report should contain the consultants' recommendations for further mitigation, and this recommendation should be considered when determining the need for and type of on-site monitoring or locality avoidance.

5. Monitor during disturbance activities. Those areas that have been determined to have a Very High potential (Class 5) for adverse impacts should typically be monitored at all times when surface-disturbing activities are occurring. If the area has a High potential (Class 4), it may be appropriate to examine the exposed unit, including the spoil or storage piles, only at key times. These times are dependent on the activity, but typically are: when bedrock is initially exposed, occasionally during active excavation, and when the maximum exposure is reached and before backfilling has begun. This monitoring and spot-checking must be performed by a permitted paleontologist or their BLM-approved representative. The monitor has the authority to briefly pause any activity to inspect a possible find. These pauses are intended to allow for identification of possible fossil resources and should only last a few minutes to a couple hours.

6. Evaluate significant finds. If significant paleontological resources are discovered during surface disturbing actions or at any other time, the proponent or any of his agents must: (a) stop work immediately at that site; (b) contact the appropriate BLM representative, typically the project inspector or Authorized Officer, as soon as possible; and (c) make every effort to protect the site from further impacts, including looting, erosion, or other human or natural damage. The BLM or designated paleontologist will evaluate the discovery and take action to protect or remove the resource within 10 working days. Work may not resume at that location until approved by the official BLM representative. In some cases, such as recovery of a dinosaur, further activity at that site may be delayed until the discovered fossils are recovered, or until the project is modified to avoid impacting the find. Because of the potential for lengthy delays, the BLM should assure that the project proponent understands this possibility prior to approval to begin work.

These steps are included here to provide general guidance, and it may be appropriate to modify or skip them for various situations. However, a brief discussion of the background and reason for modification should be placed in the project file.

For all surface-disturbing activities occurring within Class 3 or higher units, a stipulation should be included in the permitting document.

Further Information

Detailed information on the geologic units and paleontological resources within a State can often be obtained from State geological surveys, geological or paleontological museums, geology departments at universities or colleges, paleontological permittees or other researchers or within the BLM from Regional Paleontologists or knowledgeable Geologists.

Scientific publications, such as professional journals or State geological survey reports, often contain general and detailed information about paleontological and geological resources relevant to fossil potential and occurrences for specific areas. Current and past paleontological permittee reports usually include precise locality data and maps, and often contain discussions of findings and their significance.

Appendix C

Special Status Species Potentially Occurring in the GHPA

Appendix C Special Status Species Identified for the Cameco Gas Hills EIS

Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Mammals						
Black-footed ferret	*Mustela nigripes*	FE	This species inhabits prairie dog colonies within semi-arid grasslands and mountain basins. Primarily a nocturnal species that is solitary except during the breeding season. The only known populations are in captivity or have been reintroduced. Efforts are being made throughout the Great Plains, western U.S., and Mexico to reintroduce this species into suitable habitats.	None. The USFWS has block-cleared all white-tailed prairie dog colonies within the project area. The nearest re-introduced population is approximately 60 miles southeast of the project area in the Shirley Basin.	Yes. Due to the project area occurring entirely within USFWS block-cleared areas and the large geographic distance to the nearest reintroduced population.	BLM 2007a; Fitzgerald et al. 1994; USFWS 2004.
Long-eared myotis	*Myotis evotis*	BLM	This species occupies coniferous forest. It is most common in ponderosa pine woodlands but also occurs in pinyon-juniper woodlands and subalpine forests.	None. No suitable nesting or foraging habitat occurs within the project area.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; Fitzgerald et al. 1994; WGFD 2010.
Pygmy rabbit	*Brachylagus idahoensis*	BLM	This species requires dense sagebrush for cover as well as appropriate deep soils for burrowing (i.e., high clay content). Often found in drainages with taller sagebrush present.	Low. Marginal sagebrush habitat occurs in the project area and this species has not been found during recent surveys within the project area.	No.	BLM 2004; HWA 2011; WGFD 2010.
Spotted bat	*Euderma maculatum*	BLM	The spotted bat is known to occur in montane forests, pinyon-juniper woodlands, and open semi-desert shrublands. This species occupies ponderosa pine forests during the breeding season and lower elevations during other times of the year.	High. Breeding habitat does not occur within the project area; however suitable foraging habitat occurs within the project area.	No.	Fitzgerald et al. 1994; WGFD 2010a,b.
Swift fox	*Vulpes velox*	BLM	The swift fox inhabits short-grass and mid-grass prairie and may be associated with prairie dog colonies. Dens typically occur on small hills and ridges.	None. This species is not known to occur within the project area.	Yes. The project area is outside the known distribution of this species in Wyoming.	BLM 2007a; Fitzgerald et al. 1994; WGFD 2010.

Appendix C Special Status Species Identified for the Cameco Gas Hills EIS

Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Townsend's big-eared bat	*Corynorhinus townsendii*	BLM	This species occupies semi-desert shrublands, pinyon-juniper woodlands, and open montane forests. It is frequently associated with caves and abandoned mines but will also utilize abandoned buildings and rock crevices for refuge.	High. Suitable roosting and foraging habitat occurs within the project area.	No.	BLM 2007a; Fitzgerald et al. 1994; WGFD 2010.
White-tailed prairie dog	*Cynomys leucurus*	BLM	Colonies of this species occur primarily in mountain basins, semi-desert grasslands, and open shrublands. This species is typically distributed in relatively large, sparsely populated complexes and live in loosely knit clans.	High. This species occurs within the project area. Surveys in 2009, 2010, and 2011 documented 6 colonies within the project area.	No.	BLM 2007a; Fitzgerald et al. 1994; HWA 2011; WGFD 2010.
Birds						
Bald eagle	*Haliaeetus leucocephalus*	BLM	This species typically occurs near large perennial waterbodies that support suitable roosting and foraging habitat. Nests are commonly built in large cottonwoods or conifers along lakes or rivers. During the winter, this species tends to concentrate in areas with abundant food sources such as wounded waterfowl, carrion, and fish.	None. No suitable nesting or foraging habitat occurs within the project area. This species has not been documented during recent surveys within the project area.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; Johnsgard 1990; WGFD 2010.
Brewer's sparrow	*Spizella breweri*	BLM	This species typically occurs in basin-prairie and mountain-foothills shrublands, especially sagebrush and woodland chaparral. Nests typically occur in shrubs.	High. This species is known to occupy suitable habitats within the project area and has been documented during recent surveys within the project area.	No.	BLM 2007a; HWA 2011; WGFD 2010.
Burrowing owl	*Athene cunicularia hypugea*	BLM	This species is found in non-riparian habitats including abandoned burrows of prairie dogs, ground squirrels, foxes, and badgers in grassland and open shrubland communities.	High. Suitable habitat for this species (i.e., white-tailed prairie dog colonies) occurs within the project area. However, this species has not been documented during recent surveys in the project area.	No.	BLM 2007a; HWA 2011; Johnsgard 1988; WGFD 2010.

Appendix C Special Status Species Identified for the Cameco Gas Hills EIS

Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Ferruginous hawk	*Buteo regalis*	BLM	This species occurs in open semi-arid habitats including basin-prairie shrubland, mountain-foothills, and badlands. Nest sites include short trees, ledges, and rock outcrops in sagebrush valleys and rolling grassland habitat.	High. While no active nests have been identified within 1-mile of the project area, one active nest occurs outside the 1-mile survey buffer occur near the project area. Suitable nesting and foraging habitat occurs within the project area.	No.	BLM 2007a; HWA 2011; Johnsgard 1990; WGFD 2010.
Greater sage-grouse	*Centrocercus urophasianus*	FC; BLM	This species inhabits sagebrush shrublands and grasslands. Breeding grounds (leks) are generally located in open areas such as broad ridges, grassy areas, and disturbed sites, adjacent to suitable nesting habitat. Most nesting occurs in sagebrush stands with adequate canopy cover and an understory of forbs and grasses. Winter habitat typically consists of south- and east-facing slopes with minimal snow cover.	High. This species is known to occur within suitable sagebrush habitat within the project area. No lek sites are found within the project area but two active leks occur 0.78 and 1.85 miles west of the project area. Suitable nesting and brooding habitat occurs within the project area.	No.	BLM 2007a; Connelly et al. 2004, 2000; HWA 2011; WGFD 2010.
Loggerhead shrike	*Lanius ludovicianus*	BLM	The loggerhead shrike typically inhabits open riparian areas, agricultural areas, grasslands, and shrublands (especially semi-desert shrublands). Nest sites usually occur in isolated trees or large shrubs.	High. This species is known to occupy suitable habitats within the project area and has been documented during recent surveys within the project area.	No.	BLM 2007a; HWA 2011; WGFD 2010.
Long-billed curlew	*Numenius americanus*	BLM	This species typically inhabits grasslands and wet meadows.	None. The project area is not within the know distribution of this species in Wyoming.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; WGFD 2010.
Mountain plover	*Charadrius montanus*	BLM	This species inhabits flat, short-grass prairie in areas recently burned, overgrazed by livestock, or occupied by prairie dog colonies.	High. This species is a late spring/summer resident within the project area and has been documented within the project area. Approximately 141 acres of potentially suitable habitat occurs within 0.25 mile of the project area,	No.	BLM 2007a; HWA 2011; WGFD 2010; WYNDD 2011.

Appendix C Special Status Species Identified for the Cameco Gas Hills EIS

Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Northern goshawk	*Accipiter gentilis*	BLM	This species occupies mature, close-canopied coniferous and aspen forests. The northern goshawk typically selects open, older-aged class coniferous forests and aspen stands for nesting.	None. Habitats typically associated with this species do not occur within the project area.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; Johnsgard 1990.
Peregrine falcon	*Falco peregrinus*	BLM	This species typically breeds in foothills and mountain areas. Nest sites are often located on ledges of high, steep-walled cliffs. Preferred foraging habitat includes marshes, lakes, rivers, and wet meadows.	None. Suitable nesting habitat does not occur within the project area.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; Johnsgard 1990.
Sage sparrow	*Amphispiza belli*	BLM	This species inhabits basin-prairie and mountain-foothills shrublands. Nesting typically occurs in or beneath sagebrush.	High. This species occurs in suitable habitats found within the project area but has not been documented during recent surveys within the project area.	No.	BLM 2007a; HWA 2011; WGFD 2010.
Sage thrasher	*Oreoscoptes montanus*	BLM	This species inhabits basin-prairie and mountain-foothills shrublands. Nesting typically occurs in or beneath sagebrush.	High. This species occurs in suitable habitats found within the project area but has not been documented during recent surveys within the project area.	No.	BLM 2007a; HWA 2011; WGFD 2010.
Trumpeter swan	*Cygnus buccinators*	BLM	This species inhabits lakes, ponds, marshes, and wetlands. Nests often occur on muskrat dens or small islands. Most of the North American population winters in Idaho.	None. This species is not known to nest within the project area.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; WGFD 2010.
White-faced ibis	*Plegadis chihi*	BLM	The white-faced ibis inhabits marshes, wetlands, wet meadows, and streams. Nesting habitat usually consists of dense vegetated islands surrounded by water >18 inches in depth.	None. This species is not known to nest within the project area.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; WGFD 2010.
Yellow-billed cuckoo	*Coccyzus americanus*	BLM	This species inhabits lowland deciduous woodlands, willow, and alder thickets, mature cotton-wood-riparian woodlands, deserted farmlands, and orchards. Breeding typically occurs in dense, mature riparian woodlands.	None. Suitable breeding habitat does not occur within the project area.	Yes. Occurrence would be limited to migrating or dispersing individuals.	BLM 2007a; Stokes and Stokes 1996; WGFD 2010.

Appendix C Special Status Species Identified for the Cameco Gas Hills EIS

Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Amphibians						
Boreal Toad	*Bufo boreas boreas*	BLM	Inhabits wet areas in foothills, montane, and subalpine zones from 6,500 to 12,000 feet in elevation.	None. This species range in Wyoming is west of the project area.	Yes. No records of occurrence exist for this species within the project area.	Baxter and Stone 1980; WGFD 2010.
Columbia spotted frog	*Rana luteiventris*	BLM	Found in sub-alpine forests, grasslands, and sagebrush habitats at elevations from 1,700 feet to 6,400 feet.	None. This species range in Wyoming is west of the project area.	Yes. No records of occurrence exist for this species within the project area.	Baxter and Stone 1980; WGFD 2010.
Great Basin spadefoot	*Spea intermontana*	BLM	Prefer sagebrush communities below 6,000 feet in elevation, although they have been found at elevations of 9,200 feet. This species require loose soil to burrow.	High. Suitable habitat occurs within the project area along the drainages and near wetland/riparian habitats.	No.	Baxter and Stone 1980; HWA 2011; WGFD 2010.
Northern leopard frog	*Rana pipiens*	BLM	Typical habitats include wet meadows and the banks and shallows of marshes, ponds, glacial kettle ponds, beaver ponds, lakes, reservoirs, streams, and irrigation ditches. Breeding season is generally May 1 - August 15.	High. Suitable habitat occurs within the project area along the drainages and near wetland/riparian habitats.	No.	Baxter and Stone 1980; BLM 2007a; HWA 2011; WGFD 2010.
Fish						
Yellowstone cutthroat trout	*Oncorhynchus clarkii bouvieri*	BLM	The Yellowstone cutthroat lives in lakes, large rivers, and small tributary streams. Native to the Yellowstone River drainage downstream to the Tongue River, including the Big Horn and Clarks Fork River drainages, this trout is also found in Pacific Creek and other Snake River tributaries.	None. This species range in Wyoming is west of the project area.	Yes. No records of occurrence exist for this species within the project area.	WGFD 2010.
Plants						
Barneby's clover	*Trifolium barnebyi*	BLM	Found on ledges, crevices, and seams, mainly on reddish-cream Nugget Sandstone, secondarily on Frontier Sandstone. Elevation range from 5,500 to 6,780 feet amsl. Flowering May to July.	None. Local endemic, that is known from five extant occurrences in the southeastern foothills of the Wind River and southern Beaver Rim area in Fremont County, Wyoming.	Yes. Based on the limited distribution and geographic range of the species, habitat for the species is not found in the Permit Area.	WYNDD 2011b.

Appendix C Special Status Species Identified for the Cameco Gas Hills EIS

Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Beaver Rim phlox	*Phlox pungens*	BLM	Sparsely vegetated slopes on sandstone, siltstone, or limestone (in the Wind River Basin) and on cays and shales (in the Green River Basin). Elevation range 6,000 to 7,400 feet amsl. Flowering May-June.	High. Patches of suitable habitat for the species was identified in the Permit Area during field surveys conducted by Hayden-Wing.	No.	HWA 2010; WYNDD 2011b.
Blowout penstemon	*Penstemon haydenii*	FE	Substrate of eroding and shifting sand with low vegetation cover, typically found in “blowouts” (i.e., depressions in the topography caused by wind erosion) with less than 10 percent basal ground cover. In Wyoming, blowout penstemon is found primarily on the rim and lee slopes of blowouts, and associated steep slopes deposited at the base of foothills. Elevation range is unknown, but typically found at elevations of 5,860 to 7,440 feet. Flowering mid May to late June.	Low. Known within the Sandhills region of Nebraska and the northeastern Great Divide Basin in Carbon County,	Yes. Based on field surveys conducted by Hayden-Wing, there is no suitable habitat for the species with the Permit Area.	Fritz 1992; WYNDD 2011b; USFWS 1999, Stubbendieck, et al. 1989.
Cedar Rim thistle	*Cirsium aridum*	BLM	Sparsely vegetated openings in Wyoming big sagebrush grasslands on barren chalky hills, gravelly slopes, fans and fine-textured sandy-shaley draws. Typically found on whitish-gray sandstone, chalk, tufaceous colluvium or clay substrates derived from the Split Rock, White River, Wagon Bed, Wind River, Green River, and Wasatch formations. Elevation range 5,800 to 7,500 feet amsl. Flowering June to July.	High. The species has been observed in the vicinity of project area. Suitable habitat for the species was identified in the Permit Area during field surveys conducted by Hayden-Wing.	No.	NatureServe 2010; WYNDD 2011b. HWA 2010.
Desert yellowhead	*Yermo xanthocephalus*	FT	Sparsely vegetated cushion plant communities on low slopes, rims, colluvial fans, and bottoms found in shallow deflation hollows shaped by wind and erosion. Typically found on outcrops of sandstone in the Split Rock Formation. Elevation range 6,720 to 6,760 feet amsl. Flowering June to July.	Low. The species is known from one occurrence in the Sweetwater River Plateau in Fremont County, Wyoming.	Yes. Based on field surveys conducted by Hayden-Wing, suitable habitat for the species is not located within the Permit Area.	HWA 2010; WGFD 2004.

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Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Dubois milkvetch	*Astragalus gilviflorus* var. *purpureus*	BLM	Sparsely vegetated cushion plant and bunchgrass communities which may have scattered individuals of Wyoming big sagebrush, mountain big sagebrush, or black sagebrush. Typically found on mid to upper slopes near the crest of badland ridges or low knolls on sandy-clay soils with abundant surface gravel derived from the Tertiary Wind River or Indian Meadows formations, although some populations occur on deposits of the Cretaceous Cody Shale, Triassic Chugwater and Dinwoody formations, Paleozoic limestones, or gravelly moraines. Elevation range 6,400 to 8,800 feet amsl. Flowering late May to early July.	None. Local endemic of the Dubois Badlands in the northwestern Wind River Basin and adjacent foothills of the northeastern Wind River and southern Absaroka ranges in Fremont County, Wyoming.	Yes. Based on the limited distribution and known occurrences of the species, it is unlikely the species would be found in the Permit Area.	WYNDD 2011b.
Fremont's bladderpod	*Lesquerella fremontii*	BLM	Cushion plant communities in meadows, slopes, ridges, and benches on rocky, mesic, limestone derived soils, primarily in arid foothills and desert ridges, but may also occasionally occur in cushion plant communities near timberline. Elevation to 6,800 to 11,100 feet amsl. Flowering May-July.	Low. Local endemic of the east slope of the Wind River Range and Sweetwater Plateau in Fremont County.	Yes. Based on the limited range of the species, it is unlikely the species would be found in the Permit Area.	WYNDD 2011b.
Laramie columbine	*Aquilegia laramiensis*	BLM	Found on shady, level microsites on crevices and ledges in granite boulders, outcrops, ledges, or cliffs within the Laramie Mountains in Albany and Converse counties. Elevation range from 5,400 to 10,100 feet amsl. Flowering June-August.	None. The species range is located south of the Permit Area in Albany and Converse counties.	Yes. Based on the limited distribution and geographic range of the species, suitable habitat for the species is not located in the Permit Area.	BLM 2007a, Marriott and Pokorny 2006.

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Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Laramie false sagebrush	*Sphaeromeria simplex*	BLM	In cushion plant communities on rocky limestone soils on gentle slopes or rims of dry, rocky limestone-sandstone "pebble plains" in wind scoured openings. Surrounding vegetation communities typically are densely vegetated forest or shrubland communities. Elevation range 7,200 to 8,760 feet amsl. Flowering May to August.	None. Endemic to southeast Wyoming in the western foothills of the Laramie Range, Shirley Basin, and Shirley Mountains (Albany, Carbon, Converse, and Natrona counties).	Yes. Based on the limited distribution, and elevation range, it is unlikely the species would be found in the Permit Area.	BLM 2007a, NatureServe 2011; WYNDD 2011b.
Limber pine	*Pinus flexilis*	BLM	Dry, rocky sites in forested regions on mesic sites in low density, open area. In Wyoming, it is typically found with Rocky Mountain lodgepole pine, Engelmann spruce, whitebark pine, Rocky Mountain Douglas-fir, subalpine fire, Rocky Mountain juniper, and common juniper. General elevation range 4,000 to 12,500 feet amsl; specific elevation ranges for Wyoming are not available. Buds burst late April to late June, while pine cones ripen from August to September, and seeds are dispersed from September to October	High. Stands of limber pine have been observed in the Permit Area during biological surveys conducted by Hayden-Wing.	No.	Johnson 2001; HWA 2010; NatureServe 2010.
Many-stemmed spider flower	*Cleome multicaulis*	BLM	Whitish, alkali playa wetlands with soils that have a strong scent of hydrogen sulfide. Typically found with alkali cordgrass, saltgrass, Baltic Rush, Nuttall's alkaligrass, Nevada bulrush, and seaside arrowgrass. Elevation range 5,860 feet amsl. Flowering June-August.	None. In Wyoming, populations are restricted to the Sweetwater River Valley in southern Natrona County.	Yes. Based on the limited distribution and known occurrences of the species, it is unlikely the species would be found in the Permit Area.	BLM 2007a
Meadow pussytoes	*Antennaria arcuata*	BLM	Primarily found in subirrigated meadows within broad stream channels. Typically associated species include tufted hairgrass, Baltic rush, Kentucky bluegrass, Sandberg bluegrass on hummocks, level ground or shallow depressions on alkaline, clayey soils high in organic matter. Elevation range 4,950 to 7,900 feet amsl. Flowering July to September.	Low. The species is known from 23 occurrences primarily along broad stream channels in the South Pass area of the southern Wind River Range southwest of the Permit Area.	Yes. While the species is found in Fremont County, suitable habitat for the species is not located in the Permit Area.	BLM 2011b; WYNDD 2011b.

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Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Owl Creek Miner's candle	*Cryptantha subcapitata*	BLM	Sparsely vegetated cushion plant communities on sandy-gravelly slopes and desert ridges. Typically found in areas dominated by rock tansy, or black sagebrush. Restricted to sandstones and conglomerates derived from the Eocene Wind River Formation, but has been reported on limestone. Elevation range 4,700 to 6,000 feet amsl. Flowering May-June.	Low. Narrow endemic of the Owl Creek and Bridger Mountains in the vicinity of Boysen Reservoir and the northern Wind River Basin in Fremont County, Wyoming.	Yes. Based on the limited range of the species, it is unlikely the species would be found in the Permit Area.	WYNDD 2011b.
Persistent sepal yellowcress	*Rorippa calycina*	BLM	Moist sandy to muddy banks of streams, stock ponds, and man-made reservoirs near the high water line, high plain swales that evaporate, and along creeks. Elevation range 3,660 to 6,800 feet amsl. Flowering late May to August (extending into October).	Moderate. Suitable habitat for the species was identified in the GHPA during field surveys conducted by Hayden-Wing.	No.	HWA 2010; WYNDD 2011b.
Porter's sagebrush	*Artemisia porteri*	BLM	Sparsely vegetated badlands of ashy or tufaceous mudstones and clay slopes. In the northern Wind River Basin, this species is found in semi-barren, low desert shrub communities dominated by birdfoot sagebrush, Porter's wormwood, or longleaf wormwood, Substrates are dry, whitish, ashyclay hills, gravelly-clay flats, and shaley erosional gullies of the Wind River, Wagon Bed, and Frontier formations. Elevation range 5,300 to 6,500 feet amsl. Flowering June-July.	Low. State endemic restricted to the Wind River Basin and Powder River Basin in Fremont, Johnson, and Natrona counties.	Yes. Based on agency consultation, and elevation range of the species, it is unlikely that the species would be found in the Permit Area.	BLM 2007a; WYNDD 2011b.
Rocky Mountain twinpod	*Physaria saximontana* var. *saximontana*	BLM	Sparsely vegetated slopes on sandy, gravelly soils, or talus of limestone, red sandstone, or clay. Elevation range 5,200 to 8,300 feet. Flowering May to late-June; mature fruits present late-June to August.	High. Suitable habitat for the species was identified in the Permit Area during field surveys conducted by Hayden-Wing.	No.	HWA 2010; WYNDD 2011b.

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Common Name	Scientific Name	Status[1]	Habitat Association	Potential for Occurrence Within the Project area	Eliminated From Detailed Analysis (Yes/No)	References
Shoshonea	*Shoshonea pulvinata*	BLM	Shallow, stony, calcareous soils of exposed limestone outcrops, ridge tops, and talus slopes. Associated with other low growing forbs and cushion plants on sites with sparse cover. Elevation range 5,800 to 9,200 feet amsl. Flowering Mid-May to Mid-July.	None. Regional endemic of northwest Wyoming and south-central Montana. In Wyoming, known only from the eastern Absaroka and Owl Creek mountains in Fremont, Hot Springs, and Park counties.	Yes. Based on the limited species range, it is unlikely the species would be found in the Permit Area.	WYNDD 2011b.
Ute's ladies'-tresses orchid	*Spiranthes diluvialis*	FT	An aquatic or wetland-dependent occupying moist to very wet, somewhat alkaline or calcareous native meadows near streams, springs, seeps, lake shores, or in abandoned stream meanders that still retain ample ground water. Typically in Wyoming found on gravel bars, wet meadow terraces, oxbows, seeps; sometimes found in springs, fens, lakes and excavations within suitable settings, including ditches and quarries. In Wyoming, the elevation range is typically from 4,750 to 5,400 feet amsl. Flowering July to August.	Low. In Wyoming, the species occurs at four locations on the Western Great Plains in Converse, Goshen, Laramie, and Niobrara counties.	Yes. Based on field surveys conducted by Hayden-Wing, there is no suitable habitat for the species with the Permit Area.	WYNDD 2011b.
Williams' Wafer parsnip	*Cymopterus williamsii*	BLM	Endemic to limestone habitats in the Bighorn Mountains. Found on open, south or east-facing ridgetops and upper slopes with exposed limestone outcrops or talus on thin, sandy soils. Often restricted to small cracks or pockets in limestone bedrock, Common associates include curl-leaf mountain mahogany and Ponderosa pine. Elevation range 6,000 to 8,300 feet amsl. Flowering May to mid-June.	None. State endemic restricted to the Bighorn Mountains of north-central Wyoming in Bighorn, Johnson, Natrona, and Washakie counties.	Yes. Based on the limited range of the species, it is unlikely the species would be found in the Permit Area.	BLM 2007a; WYNDD 2011b.

[1] FE = Federally listed as endangered.
FT = Federally listed as threatened.
FC = Federal candidate.
FP = Federally proposed.
BLM = BLM Sensitive Species.

Appendix D

Migratory Birds Potentially Occurring in the GHPA

Appendix D Migratory Bird Species on the USFWS Birds of Conservation Concern List and Wyoming Partners in Flight High Priority Bird Species List Potentially Occurring within the Study Area

Common Name	Scientific Name	USFWS Birds of Conservation Concern	Wyoming Partners in Flight High-Priority Bird Species	Primary Breeding Habitat	Secondary Breeding Habitat	Winter Habitat
American bittern	*Botaurus lentiginosus*		X	Wetland	Wet meadow	Migrant
Bald eagle	*Haliaeetus leucocephalus*	X	X	Riparian	Agriculture	Riparian
Burrowing owl	*Speotyto cunicularia*		X	Grassland	Sagebrush shrubland	Migrant
Brewer's sparrow	*Spizella breweri*	X	X	Sagebrush shrubland	Grassland	Migrant
Ferruginous hawk	*Buteo regalis*	X	X	Sagebrush shrubland	Grassland	Grassland
Greater sage-grouse	*Centrocercus urophasianus*		X	Sagebrush shrubland	Grassland	Sagebrush shrubland
Loggerhead shrike	*Lanius ludovicianus*	X		Grassland	Sagebrush shrubland	Migrant
Long-billed curlew	*Numenius americanus*	X	X	Playa	Grassland	Migrant
Mountain plover	*Charadrius montanus*		X	Grassland	Sagebrush shrubland	Migrant
Peregrine falcon	*Falco peregrinus*	X	X	Cliff	Lowland Riparian	Wetland
Sage sparrow	*Amphispiza belli*	X	X	Sagebrush shrubland	Grassland	Migrant
Sage thrasher	*Oreoscoptes montanus*	X		Sagebrush shrubland	Grassland	Migrant
Short-eared owl	*Asio flammeus*		X	Sagebrush shrubland	Grassland	Migrant
Swainson's hawk	*Buteo swainsoni*	X	X	Agriculture	Grassland	Migrant
Upland sandpiper	*Bartramia longicauda*	X	X	Grassland	Grassland	Migrant
Wilson's phalarope	*Phalaropus tricolor*		X	Wetland	Playa	Migrant
Willow flycatcher	*Empidonax traillii*	X		Riparian	Wetland	Migrant

Source: Nicholoff 2003; USFWS 2008.

Appendix E

Air Quality Analysis Support Document for the Gas Hills ISR Uranium Project EIS

Air Quality Analysis Support Document for Gas Hills ISR Uranium Project EIS

List of Acronyms

°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
AQCR	Air Quality Control Region
AQRV	air quality related value
CAA	Clean Air Act
CFR	Code of Federal Register
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
GHG	greenhouse gas
HAP	Hazardous Air Pollutants
IPCC	Intergovernmental Panel on Climate Change
kg/gal	kilograms per gallon
kWh	kilowatt hour
MACT	Maximum Achievable Control Technology
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NH_3	ammonia
NH_4	ammonium
NO_2	nitrogen dioxide
NO_X	Nitrogen oxides
NP	National Park
NPS	National Park Service
NSPS	New Source Performance Standards
NSR	New Source Review
OEL	Occupational Exposure Level
PM	particulate matter
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
ppm	parts per million
PSD	Prevention of Significant Deterioration
REL	Reference Exposure Level

RfC	Reference concentrations
SO_2	sulfur dioxide
tpy	tons per year
TSL	toxic screening level
TSP	total suspended particulates
USEPA	United States Environmental Protection Agency
VOC	volatile organic compounds

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1.0 Introduction

AECOM Technical Services, Inc. (AECOM) developed this air quality analysis support document on behalf of the Bureau of Land Management (BLM) to document the methods used in the analysis of air quality impacts resulting from the Gas Hills In-situ Recovery (ISR) Uranium Mine Project (Gas Hills Project or Project) located in Fremont and Natrona counties, Wyoming, proposed by Power Resources, Inc., doing business as Cameco Resources (Cameco).

The purpose of the Project is to explore for and identify ore reserves and extract approximately 1 million to 2.5 million pounds of uranium per year over an anticipated project life of 25 years. The Gas Hills Project would use ISR methods and would be operated as a satellite facility to the Cameco Smith Ranch-Highland uranium ISR facility currently operating in Converse County Wyoming. One existing large building and one new structure would house the site's central processing facilities. The surface disturbance would be limited to the construction of water wells, buried water pipelines, single-lane gravel access roads, power infrastructure, and small buildings for well-head manifold control equipment known as header houses.

The ISR recovery method uses chemical removal of the uranium mineral from the host rock in place, and does not require physically removing and crushing ore-bearing rock. Unlike conventional mining practices, ISR methods do not use large earth-moving equipment or blasting, and require no waste rock or tailings disposal. The ISR methodology utilizes a solution consisting of oxygen and carbon dioxide or bicarbonate which is injected via conventional water wells into uranium ore-bearing rock formations in the subsurface. The solution dissolves the uranium ore from the rock formations into the circulating groundwater and the resultant uranium-bearing groundwater is recovered by pumping wells located adjacent to the injection wells. The groundwater containing uranium is then processed through an ion exchange facility where the uranium is precipitated onto a resin bead media. For this Project, the resin beads containing uranium would then be transported to the Smith Ranch-Highland facility (approximately 140 road miles) for processing into uranium yellowcake. After stripping the uranium from the resin bead media, it would be returned to the Project site for re-use.

The Gas Hills Project Area (GHPA) is defined by the mine permit boundary and covers approximately 8,500 surface acres (approximately 13 square miles). Project activities would occur both within the GHPA and within individual mine units (potential uranium recovery areas). Activities that would occur within the mine units would include the drilling of exploratory boreholes; installation of monitoring wells, injection wells, and production wells; construction of distribution and gathering pipelines and header houses, and construction of roads to the header houses. Activities that would occur within GHPA but outside the mine units would include construction of uranium processing and waste water treatment facilities and development of new and improvement of existing access roads, pipelines, and electrical lines.

Surface disturbance within mine units would not occur all at once but would be phased over several years, depending on the uranium production rate and the availability of construction equipment and personnel. Cameco estimates that of the approximately 1,500 acres that would be disturbed over the 25 year life of the Project. Final surface reclamation would be required by regulatory agencies and assured by bonds. Final reclamation would include plugging and abandoning all wells, removing header houses and buried piping, and re-grading and seeding the disturbed surface.

Air pollutant emissions associated with the construction, operation, reclamation, and decommissioning activities at the Gas Hills Project site includes emissions from fuel combustion and fugitive dust emissions from the following sources:

- Construction equipment and vehicles for site preparation, reclamation, and decommissioning of surface facilities;

- Well-drilling equipment and vehicles for drilling production and monitor wells;
- Natural gas-or propane-fired heating units for the satellite facility;
- Trucks for transporting construction materials as well as the product of the Gas Hills Project (uranium-laden ion exchange resin);
- Trips to disposal sites;
- Truck deliveries and other operational activities; and
- Light-duty vehicles for commuting by construction crew and employees.

Based on preliminary estimates of emissions including construction of new facilities, improvement of some roads, and other production and delineation drilling activities (NRC 2004), the Project could increase emissions of nitrogen oxides (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter (PM) including PM with an aerodynamic diameter less than 10 micrometers (PM_{10}), and PM with an aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$).

Air toxics emissions are also considered in the analysis. According to USEPA, modeling of air toxics is generally only warranted for sources that pose the greatest health threat in urban areas, or when the emissions approach levels of 10 tons per year individually or 25 tpy in the aggregate, or is one of the listed NESHAP sources. The emissions of air toxics from the proposed Project would be less than the levels generally required to warrant air toxics modeling.

Ozone is not a primary air pollutant directly that would be emitted by the proposed Project, or by most other air pollution sources. Instead, it is principally created from the chemical reaction of NO_X and volatile organic compounds (VOCs) in the air under direct exposure to sunlight. The project would be a small source of NO_X and VOCs, not at the magnitude that would justify regional ozone modeling. Modeling for ozone formation and transport is a highly complex and resource intensive exercise, and is typically conducted only to guide the choice of strategies to correct a monitored ozone problem in an area not attaining the NAAQS for ozone. The emissions from this project would not be expected to lead to ozone impacts.

The nearest Class I area to the GHPA site is the Bridger National Wilderness Area (NWA), which is about 95 kilometers (km), or 59 miles, from the GHPA. The modeling methods used provide conservative estimates of ambient concentrations that potentially may result from the proposed facility emissions in combination with existing sources in the region. The air quality modeling was conducted in accordance with guidance provided by the United States Environmental Protection Agency (USEPA); Guideline on Air Quality Models (published as 40 Code of Federal Regulations [CFR] 51, Appendix W) (USEPA 2005) (hereafter referred to as the Modeling Guideline).

2.0 Analysis Approach

The Project must demonstrate compliance with the Federal and state regulatory framework as outlined below. The Federal Clean Air Act (CAA) provides states with the authority to regulate air quality within state boundaries. The following subsections provide a summary of the regulatory framework associated with air quality in the Project and vicinity, as well as a description of the modeling and analysis approach for estimating air quality impacts from the Project.

2.1 Air Quality Regulatory Framework

The CAA of 1970 (42 USC 7401 et seq.) as amended in 1977 and 1990 is the basic federal statute governing air pollution. Provisions of the CAA of 1970 that potentially are relevant to the Project are listed below.

- National Ambient Air Quality Standards (NAAQS);
- Prevention of Significant Deterioration (PSD);
- New Source Performance Standards (NSPS);
- Maximum Achievable Control Technology (MACT) Standards;
- Conformity Requirements;
- Greenhouse Gas (GHG) Reporting Rule; and
- Federal Operating Permits Program.

Each of these provisions are discussed in more detail in the following subsections.

2.1.1 National and State Ambient Air Quality Standards

The Federal CAA amendments of the 1990s require all states to control air pollution emission sources so that NAAQS are met and maintained. The CAA directs the USEPA to delegate primary responsibility for air pollution control to state governments. The State of Wyoming adopted the NAAQS as state air quality standards and has added more stringent ambient air quality standards applicable only to Wyoming. In addition to these requirements, the National Park Service (NPS) Organic Act requires the NPS to protect the natural resources of the lands it manages from the adverse effects of air pollution.

The NAAQS establishes maximum acceptable concentrations for NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, O_3, and lead. Given the extremely low levels of lead emissions anticipated from Project sources, the lead standards are not further addressed in this analysis. These pollutants are known as criteria pollutants. These standards represent the maximum allowable atmospheric concentrations that may occur to protect public health and welfare, and include a reasonable margin of safety to protect the more sensitive individuals in the population. The air quality impacts in the air quality study area must meet the NAAQS, which apply nationwide and the WAAQS. Together these standards are referred to as the AAQS. An area that does not meet the AAQS is designated as a nonattainment area on a pollutant-by-pollutant basis. Applicable national and state AAQS are presented in **Table 2-1**.

Table 2-1 Applicable Federal and State AAQS

Pollutant	Averaging Period	NAAQS
CO	8-hour	9 ppm (10 mg/m^3)

Table 2-1 Applicable Federal and State AAQS

Pollutant	Averaging Period	NAAQS
	1-hour	35 ppm (40 mg/m^3)
NO_2	Annual	0.053 ppm (100 μg/m^3)
	1-hour	0.100 ppm
O_3	1-hour	0.12 ppm
	8-hour	0.075 ppm
$PM_{2.5}$	Annual	15 μg/m^3
	24-hour	35 μg/m^3
PM_{10}	Annual	Revoked
	24-hour	150 μg/m^3
SO_2	3-hour	0.50 ppm
	1-hour	0.075 ppm
Pb	Rolling 3-month	0.15 μg/m^3

2.1.2 Prevention of Significant Deterioration

New or modified large emissions sources in an attainment area are required to follow PSD regulations. PSD regulations restrict the degree of ambient air quality deterioration allowed and apply to proposed new or modified major stationary sources located in an attainment area that have the potential to emit pollutants in excess of predetermined de minimis values (40 CFR Part 51) and the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule (Tailoring Rule). As defined in 40 CFR 51 and the Tailoring Rule, a new source is considered a major stationary source if it:

1. Can be classified in one of the 28 named source categories listed in Section 169 of the CAA, and it emits or has the potential to emit 100 tons per year (tpy) or more of any criteria pollutant regulated by the CAA (USEPA 1990);
2. Is any other stationary source that emits or has the potential to emit 250 tpy or more of any criteria pollutants regulated by the CAA (USEPA 1990); or
3. Is any other stationary source constructed that emits or has the potential to emit 100,000 tpy or more of CO_2e.

The Project would be expected be a minor source for all pollutants including CO_2-equivalent (CO_2e); therefore, PSD would not apply to the Project.

Class I areas are protected by Federal Land Managers (FLMs) who manage air quality related values (AQRVs) such as visibility and atmospheric deposition. Though not a regulatory program under PSD, FLMs review the issuance of a PSD permit for any impacts that exceed guideline thresholds for these parameters. In addition to analysis of the visibility and atmospheric deposition, the change in the acid neutralizing capacity (ANC) of sensitive lakes is assessed by FLMs. The FLMs consider a source located greater than 50 km from a Class I area to have negligible impacts with respect to Class I AQRVs if its total SO_2, NO_X, PM_{10}, and H_2SO_4 annual emissions (in tons per year, based on 24-hour maximum allowable emissions), divided by the distance (in km) from the Class I area (Q/D) is 10 or less. The

Agencies would not request any further Class I AQRV impact analyses from such sources. In general, FLAG recommends that an applicant apply the Q/D test (FLAG 2010) for proposed sources greater than 50 km from a Class I area to determine whether or not any further visibility analysis is necessary. Results of the analysis (impacts) are provided in Section 4 of this document.

2.1.3 New Source Performance Standards

The regulation of new sources, through the development of standards applicable to a specific category of sources, was an important step taken by the CAA. NSPS apply to all new, modified, or reconstructed sources within a given category, regardless of geographic location or the existing ambient air quality. The standards define emission limitations that would be applicable to a particular source group. No NSPS are applicable to the Project since the mine would not be one of the listed source groups.

2.1.4 Carbon Dioxide and Other Greenhouse Gases

CO_2 and other GHGs are naturally occurring gases in the atmosphere whose status as a pollutant is not related to their toxicity, but is related to the added long-term impacts they may have on climate because of their increased incremental levels in the earth's atmosphere. Because they are non-toxic and non-hazardous at normal ambient concentrations, CO_2 and other naturally occurring GHGs do not have applicable ambient standards or emission limits under the major environmental regulatory programs.

On October 30, 2009, the USEPA issued the final mandatory reporting rule for major sources of GHG emissions (40 CFR Part 98). The rule requires a wide range of sources and source groups to record and report selected GHG emissions, including CO_2, methane (CH_4), nitrous oxide (N_2O), and some halogenated compounds. The USEPA delayed a comparable rule for GHG emissions for various petroleum and natural gas industry groups.

On June 3, 2010, the USEPA issued the Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule. The rule tailors the applicability criteria that determine which stationary sources become subject to permitting requirements for GHG emissions under the PSD and Title V programs of the CAA. Under the rule new facilities with GHG emissions of at least 100,000 tons per year (tpy) CO_2e and existing facilities with at least 100,000 tpy CO_2e making changes that would increase GHG emissions by at least 75,000 tpy CO_2e are required to obtain PSD permits. Facilities that must obtain a PSD permit to cover other regulated pollutants must also address GHG emissions increases of 75,000 tpy CO_2e or more. New and existing sources with GHG emissions above 100,000 tpy CO_2e must also obtain operating permits. The USEPA rules do not require any controls or establish any standards related to GHG emissions or impacts.

2.1.5 National Emission Standards for Air Pollutants

The CAA requires USEPA to regulate toxic air pollutants from large industrial facilities and to develop standards for controlling the emissions of air toxics from sources in an industry group (or in source categories). Under the National Emission Standards for Hazardous Air Pollutants (HAPs), the USEPA promulgated standards pursuant to Section 112 of the 1990 CAA Amendments. The rules are provided in 40 CFR 63. The standards for these sources are known as Maximum Achievable Control Technology (MACT) standards, and are based on emissions levels that are already being achieved by the better-controlled and lower-emitting sources in an industry.

USEPA is required to identify categories of industrial sources that emit one or more of the listed 187 toxic air pollutants. These industrial categories include both major and area sources, including those listed below:

- Major sources of air toxics that emit 10 tons per year (tpy) of a single air toxic or 25 tpy of a combination of air toxics.

- Area sources release smaller amounts of toxic pollutants into the air—less than 10 tpy of a single air toxic, or less than 25 tpy of a combination of air toxics. Although emissions from individual area sources are often relatively small, cumulatively their emissions can be of concern (USEPA 2009).
- In the Integrated Urban Air Toxics Strategy, the USEPA identifies the toxic air pollutants that pose a health threat in the largest number of urban areas and regulates sufficient area source categories to ensure that the emissions of these "urban" air toxics are reduced.

The Project is anticipated to be a minor source of HAPs, and there are currently no applicable area source MACT standards that apply to the Project. Emissions of HAPs are discussed in Section 3 of this document.

2.1.6 Conformity for General Federal Actions

According to Section 176I of the CAA (40 CFR 51.853), a federal agency must make a conformity determination in the approval of a project having air emissions that exceed specified thresholds in nonattainment and/or maintenance areas. The Project is not located in a nonattainment or maintenance area; therefore, a general conformity analysis is not required.

2.1.7 Federal Operating Permits Program

All major stationary sources (primarily industrial facilities and large commercial operations) emitting certain air pollutants are required to obtain Title V operating permits under the Federal Operating Permits Program outlined in 40 CFR Part 70 of the CAA. Whether a source meets the definition of "major" depends on the type and amount of air pollutants it emits and, to some degree, on the overall air quality in its vicinity. Generally, major sources include stationary facilities that emit 100 tons or more per year of a regulated air pollutant including compounds such as CO, PM_{10}, $PM_{2.5}$, volatile organics, SO_2, and NO_X. Major sources of toxic air pollutants (i.e., any source that emits more than 10 tpy of an individual toxic air pollutant or more than 25 tpy of any combination of toxic air pollutants) are also covered under the Federal Operating Permits Program. The Project would be a minor source with respect to the Federal Operating Permits Program; therefore, a Title V operating permit would not be required. Results of emissions calculations are shown in Section 3 of this document.

2.2 Fugitive Dust

2.2.1 General Construction Activities

General construction activities were assessed in a very conservative manner by assuming that all construction activities would result in emissions of 1.2 tons per acre of disturbed land per month in accordance with guidance from USEPA as described below.

Heavy construction is a source of dust emissions that may have substantial temporary impact on local air quality. Facility and road construction are two examples of construction activities with high emissions potential. Emissions during the construction of a building or road can be associated with land clearing, drilling and blasting, ground excavation, cut and fill operations (i.e., earth moving), and construction of a particular facility itself. Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions result from equipment traffic over temporary roads at the construction site.

The temporary nature of construction differentiates it from other fugitive dust sources as to estimation and control of emissions. Construction consists of a series of different operations, each with its own duration and potential for dust generation. In other words, emissions from any single construction site can be expected to 1) to have a definable beginning and an end, and 2) vary substantially over different phases of the construction process. This is in contrast to most other fugitive dust sources, where emissions are either relatively steady or follow a discernible annual cycle. Furthermore, there is often a

need to estimate area wide construction emissions, without regard to the actual plans of any individual construction project. For these reasons, following are methods by which either area wide or site-specific emissions may be estimated.

The quantity of dust emissions from construction operations is proportional to the area of land being worked and to the level of construction activity. By analogy to the parameter dependence observed for other similar fugitive dust sources, one can expect emissions from heavy construction operations to be positively correlated with the silt content of the soil (that is, particles smaller than 75 micrometers [µm] in diameter), as well as with the speed and weight of the average vehicle, and to be negatively correlated with the soil moisture content.

Based on field measurements of total suspended particulate (TSP) concentrations surrounding apartment and shopping center construction projects, the approximate emission factors for construction activity operations are 1.2 tons/acre/month of activity.

These values are most useful for developing estimates of overall emissions from construction scattered throughout a geographical area. The value is most applicable to construction operations with:

1. Medium activity level;
2. Moderate silt contents; and
3. Semiarid climate.

Because the above emission factor is referenced to TSP, use of this factor to estimate PM no greater than 10 µm in aerodynamic diameter (PM_{10}) emissions will result in conservatively high estimates. Also, because derivation of the factor assumes that construction activity occurs 30 days per month, the above estimate is somewhat conservatively high for TSP as well (USEPA 1995).

Screening dispersion modeling was performed to assess potential PM_{10} impacts of fugitive dust from disturbed areas during construction. Fugitive dust emissions from operation and reclamation of the Project would be equivalent to or less than construction emissions; hence, only construction emissions were modeled. Air modeling was performed using the USEPA screening model, SCREEN3, which is a single source Gaussian plume model and provides maximum ground-level concentrations for point, area, flare, and volume sources. SCREEN3 is a screening version of the Industrial Source Complex 3 model (ISC3). The GHPA was modeled as an area source using full meteorology as well as regulatory model default values for mixing heights and anemometer heights. Impacts that would be representative of activities in the analysis area were assessed at a distance of 50 meters from the disturbance. Results of the analysis (impacts) are provided in Chapter 4 of this document.

2.2.2 Roadway Fugitive Dust

To estimate the maximum quantity of dust generated from any single vehicle on unpaved and paved roads, calculations using USEPA methods were used. Results are expressed in pounds (lb) of size-specific particulate emissions from a road per vehicle mile traveled (VMT).

For heavy vehicles traveling on unpaved surfaces at industrial sites including sites such as the Project, emissions were estimated from the following equation:

$$E = k\,(s/12)^a\,(W/3)^b \qquad \text{(Equation 1a)}$$

and, for vehicles traveling on publicly accessible roads, dominated by light duty vehicles, emissions were estimated from the following equation:

$$E = [k\,(s/12)^a\,(S/30)^d]/(M/0.5)^c - C \qquad \text{(Equation 1b)}$$

Where:

k, a, b, c and d are empirical constants (USEPA 2006) given below in **Table 2-2** and

- E = size-specific emission factor (lb/VMT)
- s = surface material silt content (%)
- W = mean vehicle weight (tons)
- M = surface material moisture content (%)
- S = mean vehicle speed (mph)
- C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

Table 2-2 Constants for Equations 1a AND 1b

	Industrial Roads (Equation 1a)			**Public Roads (Equation 1b)**		
	$PM_{2.5}$	**PM_{10}**	**PM_{30}***	**$PM_{2.5}$**	**PM_{10}**	**PM_{30}***
k (lb/VMT)	0.15	1.5	4.9	0.18	1.8	6.0
a	0.9	0.9	0.7	1	1	1
b	0.45	0.45	0.45	-	-	-
c	-	-	-	0.2	0.2	0.3
d	**-**	**-**	**-**	0.5	0.5	0.3
C (lb/VMT)				0.00036	0.00047	0.00047

Long term average emissions are inversely proportional to the frequency of measurable (> 0.254 mm [0.01 inch]) precipitation, so to account for rainfall a correction term is applied as expressed in the following equation:

$$E_{ext} = E[(365-P)/N] \qquad \text{(Equation 2)}$$

Where:

- E_{ext} = annual size specific emission factor extrapolated for natural mitigation (lb/VMY);
- E = size-specific emission factor (lb/VMT);
- *P* = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period; and
- N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

For paved roads, the quantity of particulate emissions from re-suspension of loose material on the road surface due to vehicle travel on a dry paved road was estimated using the following empirical expression:

$$E_p = k\,(sL)^{0.91} \times (W)^{1.02} \qquad \text{(Equation 3)}$$

Where:

- E_p = particulate emission factor (having units matching the units of k);
- k = particle size multiplier for particle size range and units of interest (see below);
- sL = road surface silt loading (grams per square meter) (g/m2); and
- W = average weight (tons) of the vehicles traveling the road.

Applying the precipitation correction term results in the following equation:

$$E_{pc} = [k\ (sL)^{0.91} \times (W)^{1.02}]\ (1 - P/4N) \qquad \text{(Equation 4)}$$

Where k , sL , W, and S are as defined in Equation 3 and:

- E_{pc} = annual or other long-term average emission factor in the same units as k;
- P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period; and
- N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

The assumption leading to Equation 2 is based on analogy with the approach used to develop long-term average unpaved road emission factors; however, Equation 4 above incorporates an additional factor of "4" in the denominator to account for the fact that paved roads dry more quickly than unpaved roads and that the precipitation may not occur over the complete 24-hour day.

Other Assumptions

- Light vehicles such as pickup trucks weigh 2 tons.
- Heavy trucks weigh 10 tons unloaded and 38 tons loaded.
- Speeds on roads are restricted by BMP.

Best Management Practices for Air Quality

- All disturbed mine unit well, pipeline and utility trench acreage would be reclaimed and revegetated as soon as possible after construction has been completed. (PoO/Section 7.8, Cameco 2011).
- Site speed limits of 40 mph on primary roads, 30 mph on secondary roads, and 10 mph on two track roads would be implemented to reduce wildlife/vehicle collisions and generation of dust. (PoO/Section 7.6 and Operations Plan Section 3.1.9 and Plate OP-4, Cameco 2011, 1996).
- Disturbed surfaces would be scarified and contoured, if necessary, followed by topsoil placement and seeding with a BLM-approved seed mix. Areas which have been compacted would be scarified, ripped, and/or disked as necessary to relieve the compaction and prepare the subgrade for topsoil placement (PoO/Section 7.3, Cameco 2011):
  - Topsoil would be placed in a single lift to avoid compaction. On slopes of 4:1 (horizontal to vertical) or steeper, topsoil would be placed along the contour. (PoO/Section 7.3, Cameco 2011).

- All reclaimed areas would remain fenced for a period of at least two years, or until the vegetation is capable of renewing itself with properly managed grazing and without supplemental irrigation or fertilization:
  - The fencing would not be removed until BLM and DEQ agree that the revegetated areas are ready for livestock grazing. (PoO/Section 7.11, Cameco 2011).

Trucks were modeled as volume sources using full meteorology and regulatory model default values for mixing heights and anemometer heights. Impacts were assessed at a distance of 10 meters to 5,000 meters from roads in the analysis area. Results of the analysis (impacts) are provided in Section 4 of this document.

2.3 Combustion Emissions and Hazardous Air Pollutants

2.3.1 Criteria Pollutants

Emissions of criterion pollutants from internal combustion engines were calculated from emissions factors based on engine rated horsepower. Drill rig engines were assumed to have the same horsepower rating as heavy truck engines; therefore, emission rates from both types of engines were assumed to be the same. **Table 2-3** shows the criteria pollutant emission factors used to calculate emissions.

Table 2-3 Criteria Pollutant Emission Factors

Pollutant Emission Factor (lb/hp-hr)					
CO	**NO_x**	**SO_2**	**VOC**	**PM_{10}**	**CO_2**
$6.68x10^{-03}$	$3.10x10^{-02}$	$2.05x10^{-03}$	$2.47x10^{-03}$	$2.20x10^{-03}$	1.15

Conversion factors:
454 g/lb
2,000 lb/ton

2.3.2 Hazardous Air Pollutants

HAPs are those pollutants known or suspected to cause cancer or other serious health effects, such as damage to reproduction, birth defects, or adverse environmental impacts. The USEPA has classified 187 air pollutants as HAPs, including formaldehyde, benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds, and normal hexane (n-hexane).

Emissions of HAPs from internal combustion engines were calculated from emissions factors based on engine rated horsepower. Drill rig engines were assumed to have the same horsepower rating as heavy truck engines; therefore, emission rates of HAPs from both types of engines were assumed to be the same. **Table 2-4** shows the HAPs emission factors used to calculate emissions.

Table 2-4 HAPs Pollutant Emission Factors

Pollutant Emission Factor (lb/hp-hr)					
Benzene	**Toluene**	**Xylenes**	**Aceteldahyde**	**Formaldehyde**	**Propylene**
$6.53x10^{-06}$	$2.86x10^{-06}$	$2x10^{-06}$	$5.37x10^{-06}$	$8.26x10^{-06}$	$1.81x10^{-05}$

2.3.3 Greenhouse Gases

NEPA requires informed, realistic governmental decision making. CEQ provided the most recent draft guidance document in 2010 to advise federal agencies to consider, in scoping their NEPA analyses,

whether analysis of the direct and indirect GHG emissions from their proposed actions may provide meaningful information to decision makers and the public. Specifically, if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2e GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. For long-term actions that have annual direct emissions of less than 25,000 metric tons of CO_2, CEQ encourages Federal agencies to consider whether the action's long-term emissions should receive similar analysis. CEQ does not propose this as an indicator of a threshold of significant effects, but rather as an indicator of a minimum level of GHG emissions that may warrant some description in the appropriate NEPA analysis for agency actions involving direct emissions of GHGs (CEQ 2010).

The GHG analysis discloses the GHG direct and indirect emissions (power purchased from the grid) of CO_2e and provides a qualitative discussion regarding two distinct viewpoints:

1. The net impact of the Project to climate; and
2. Potential impacts to air quality and other resources due to climate change.

Project GHG emissions are presented in Section 3.3 of this document. GHGs include CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfurhexaflourides (SF_6).

2.4 Modeling and Analysis Methods

2.4.1 SCREEN3

AECOM used USEPA-approved SCREEN3 for screening level analysis for the Project sources. The capacity and number of equipment and machines, and frequency and duration of operation for each of these emission sources are listed in that table.

Fugitive dust would be generated from construction sites and stockpiles of topsoil, as well as from unpaved road surfaces, especially during dry periods and under windy conditions. The SCREEN3 analysis is intended to produce estimates of regulatory design concentrations without the need for meteorological data and is designed to produce concentrations that are equal to or greater than (e.g., conservative) the estimates produced by AERMOD with a fully developed set of meteorological and terrain data.

For $PM_{2.5}$, AECOM used the recent March 23, 2010 USEPA guidance for $PM_{2.5}$ modeling. In order to demonstrate that it is appropriate to use PM_{10} as a surrogate for $PM_{2.5}$ ambient air quality impact assessment, dispersion modeling analysis demonstrates compliance with the PM_{10} NAAQS, including an analysis of annual PM_{10} impacts. A simple example illustrating when a PM_{10} modeling analysis might serve as a surrogate for $PM_{2.5}$ modeling is to make a clearly conservative assumption that all PM_{10} emissions are $PM_{2.5}$ and the modeled PM_{10} impacts are taken as a direct surrogate for $PM_{2.5}$ impacts and compared to the $PM_{2.5}$ NAAQS (USEPA 2010). This conservative approach (i.e., all PM_{10} emissions are $PM_{2.5}$) is used for combustion sources. For fugitive dust, source specific $PM_{2.5}/PM_{10}$ emission factor ratios also may support the assumption of a more realistic yet conservative approach for taking a ratio of modeled PM_{10} ambient impacts to provide conservative estimates of $PM_{2.5}$ impacts (USEPA 2010).

To estimate the concentration of dust resulting from traffic on unpaved and paved roads, calculations using USEPA SCREEN3 model were used. Results of the analysis (impacts) are provided in Section 4 of this document.

2.4.2 Class I Visibility Analysis

Class I visibility analysis for Bridger NWA was performed using Federal Land Managers' Air Quality Related Values Work Group (FLAG) recommended analyses. The screening analysis is meant to provide a worst-case maximum impact estimate. If the results of the screening analysis show compliance

with existing regulatory requirements, then no further modeling for compliance with standards are required. The screening level analysis involves dividing the emissions from the facility by the distance to the Class I area. If the resultant ratio is below 10, then no further analysis is needed. Results of the analysis (impacts) are provided in Chapter 4.0 of this document.

3.0 Emissions Inventory

Criteria pollutant emissions due to construction, operation, traffic maintenance, and reclamation of the Project would occur from drilling wells, building roads and other Project facilities, hauling product, reclamation of surface disturbance, as well as commuter traffic, and activities along the paved and unpaved roads. Emissions would include exhaust from semi-trucks, maintenance vehicles and equipment, as well as fugitive dust from maintenance activities, wind erosion, and other vehicular traffic. Emissions of GHG would result from fuel combustion. The following sections present the estimated emissions from sources associated with Project activities.

3.1 Fugitive Dust

A generally accepted method of estimating fugitive dust emissions is to use a typical construction project. The average daily fugitive dust emissions for a typical construction project are estimated to be 1.2 tons PM_{10} per acre per month for construction activities (USEPA 1995). Use of this value is a generally accepted approach for impact analysis and is conservative, since Project construction would not involve demolition of existing structures and other activities with the potential to result in high short-term fugitive dust emissions. **Table 3-1** shows emissions rate for general construction activities. For modeling purposes, emissions are converted to grams per second per square meter.

Table 3-1 Emissions Rate for General Construction Activities

Description	Disturbed acres	Duration (mos)	Total PM_{10} (tons)	Uncontrolled (g/s)	Controlled (g/s)	Area Emission Rate (g/s/m^2)
No Action Alternative	26.7	1	32.0	$2.81 \times 10_{-06}$	$1.9642 \times 10_{-06}$	$1.81784 \times 10_{-11}$
Proposed Action Construction	1,341.7	2	3m220.1	$1.41 \times 10_{-04}$	$9.8702 \times 10_{-05}$	$1.81784 \times 10_{-11}$
Proposed Action Operations	260	12	3m744.0	$2.73 \times 10_{-05}$	$1.9127 \times 10_{-05}$	$1.81784 \times 10_{-11}$
No Action Alternative Exploration	5	12	72.0	$5.25 \times 10_{-07}$	$3.6782 \times 10_{-07}$	$1.81784 \times 10_{-11}$

Factors used:

1.2	Tons per acre per month
2000	lbs/ton
454	g/lb
3600	sec/hr
720	hr/mo
50	percent control
4046.825	m^2/acre

Table 3-2 shows annual emissions for general construction activities assuming emissions would occur at a rate of 1.2 tons per acre per month of activity, and **Table 3-3** shows emissions factors and assumptions used to calculate fugitive dust from roadways.

Table 3-2 Estimated Annual Air Pollutant Emissions from General Construction Activities

Annual Emission Rate (tpy)[1]			
Pollutant	**Construction**	**Operations**	**Decommissioning / Reclamation**
PM	9.0	4.5	1.5

[1] Annual emissions (tpy) is based on the potential to emit at the highest hourly rates and assumes 8,760 hours per year.

Table 3-3 Emission Factors and Assumptions used to Calculate Fugitive Dust from Roadways

Silt Content %	Moisture Content %	Control Efficiency %	PM_{10} Emission Factor (lb/VMT) 0.08	$PM_{2.5}$ Emission Factor (lb/VMT) 0.02
5.1	2.4	0.50	0.74	0.07

3.2 Combustion Sources

Facility sources at the GHPA would include stationary as well as mobile sources on the property including drill rigs used to install production, injection, and monitoring wells. Drill rigs also would be used for ore body delineation. Since the Project would be an ISR facility, no crushing would occur at the GHPA.

Emissions inventory includes the sources identified in **Table 3-4** and also includes mobile sources such as light and heavy duty vehicles used for commuting and product transport. Each source category includes the project phase (construction, operation, reclamation) number of units, the schedule of operations and expected duration. The emissions inventory includes criteria pollutants and hazardous air pollutants, estimated using standard emissions factors such as those available in USEPA AP-42 (USEPA 2009). Emissions are used in the SCREEN3 model and in the FLAG screening analysis to determine impacts from the Project.

3.2.1 Combustion Source Emissions

Project emissions for the types of equipment listed in **Table 3-4** are shown in **Table 3-5**. The hourly emission rates for the off-road equipment and machines during various phases of the Gas Hills Project are listed in **Table 3-6**. Hours shown in **Table 3-5** are based in the quantity of each type of equipment as shown in **Table 3-4**.

Combustion source emissions include gaseous pollutants, NO_X, VOC, CO, and SO_2 emissions, associated with the equipment used in construction, operation, reclamation, and decommissioning activities at the Gas Hills Project. Air pollutant emissions due to construction and operation of the Project would occur from drilling wells, hauling product, commuter traffic, and traffic maintenance activities along the paved and unpaved roads.

Table 3-4 Emissions Sources

Period	Stage/Purpose	Equipment Name	Model #/ Capacity	No. of Units	Freq. of Operation	Duration of Operation
Construction	Initial Construction/Well Field Road Construction	Scraper	CAT 651	1	8 hrs/day, 5 days/wk	2 months
		Bulldozer	CAT D9	1	8 hrs/day, 5 days/wk	2 months
		Motor Grader	JD 570B	1	8 hrs/day, 5 days/wk	2 months
	Well Preparation	Truck-mounted Rotary Drilling Rig, Semi-type Diesel Tractor Truck	GD1500	4 - 8	8 hrs/day, 5 days/wk	12 mo/yr
		Pump Pulling Vehicle	1-ton gas or diesel	2	8 hrs/day, 5 days/wk	12 mo/yr
		Motor Grader	JD 570B	1	8 hrs/day, 5 days/wk	3 mo/yr
		Backhoe	JD 710D	3	8 hrs/day, 5 days/wk	12 mo/yr
		Forklift	Case 586D	2	8 hrs/day, 5 days/wk	12 mo/yr
		Cementer	6 Cylinder Gas.	4	8 hrs/day, 5 days/wk	12 mo/yr
		Light-duty Truck		8 - 10	8 hrs/day, 7 days/wk	12 mo/yr
	Const. Material Transport	Heavy-duty Water Truck	1500 gal	4 - 8	8 hrs/day, 7 days/wk	12 mo/yr
	Commuting	Heavy-duty Truck – Material Transport Light-duty Vehicle from Riverton Light-duty Vehicle from Casper	Diesel Pickup/pass. car Pickup/pass.car	1 15 15	1 trip/day 1 trip/day 1 trip/day	2 mo/yr 6 mo/yr 6 mo/yr
Operation	Satellite Facility	Natural Gas- or Propane-fired Heater	0.4-0.5x106 Btu/hr	6	24 hrs/day	6 mo/yr
	Product Transport	Truck to Highland Uranium Project site via Riverton	Diesel Semi-Tractor and Trailer	2	1 trip/day	12 mo/yr
	Commuting	Light-duty Vehicle from Riverton	Pickup/pass.car	15-18	1 trip/day	12 mo/yr
		Light-duty Vehicle from Casper	Pickup/pass.car	10-12	1 trip/day	12 mo/yr

Table 3-4 Emissions Sources

Period	Stage/Purpose	Equipment Name	Model #/ Capacity	No. of Units	Freq. of Operation	Duration of Operation
Decomm./ Reclamation	Reclamation	Scraper	CAT 651	1	2 x 8 hr shift/day*	2 – 3 yrs
		Motor Grader	JD 570B	1	2 x 8 hr shift/day*	2 – 3 yrs
		Backhoe	CAT 245	2	2 x 8 hr shift/day*	2 – 3 yrs
		Heavy-duty Truck	Diesel	3	2 x 8 hr shift/day*	2 – 3 yrs
		Light-duty Truck	Pickup	15	1 trip/day	2 – 3 yrs
	Commuting	Light-duty Vehicle from Riverton	Pickup/pass. car	10	1 trip/day	2 – 3 yrs
		Light-duty Vehicle from Casper	Pickup/pass. car	10	1 trip/day	2 – 3 yrs

Table 3-5 Engine Emissions During Project Activities (tpy)

Equipment	HP	Hours[1]	CO	NO_X	SO_2	VOC	PM_{10}	CO_2
Drill Rigs	350	25,699	$3.00x10^{+01}$	$1.39x10^{+02}$	$9.22x10^{+00}$	$1.11x10^{+01}$	$9.89x10^{+00}$	$5.17x10^{+03}$
Heavy Trucks	350	887.5	$1.04\ x10^{+00}$	$4.81x10^{+00}$	$3.18x10^{-01}$	$3.84x10^{-01}$	$3.42x10^{-01}$	$1.79x10^{+02}$
Pickups	260	1,575	$1.37\ x10^{+00}$	$6.35x10^{+00}$	$4.20x10^{-01}$	$5.06x10^{-01}$	$4.50x10^{-01}$	$2.35x10^{+02}$
Scraper	250	1,000	$8.35\ x10^{-01}$	$3.88x10^{+00}$	$2.56x10^{-01}$	$3.09x10^{-01}$	$2.75x10^{-01}$	$1.44x10^{+02}$
Dozer	300	1,000	$1.00\ x10^{+00}$	$4.65x10^{+00}$	$3.08x10^{-01}$	$3.71x10^{-01}$	$3.30x10^{-01}$	$1.73x10^{+02}$
Grader	300	1,000	$1.00\ x10^{+00}$	$4.65x10^{+00}$	$3.08x10^{-01}$	$3.71x10^{-01}$	$3.30x10^{-01}$	$1.73x10^{+02}$
Pump Pulling Vehicle	260	2,000	$1.74\ x10^{+00}$	$8.06x10^{+00}$	$5.33x10^{-01}$	$6.42x10^{-01}$	$5.72x10^{-01}$	$2.99x10^{+02}$
Backhoe	200	3,000	$2.00x10^{+00}$	$9.30x10^{+00}$	$6.15x10^{-01}$	$7.41x10^{-01}$	$6.60x10^{-01}$	$3.45x10^{+02}$
Forklift	100	2,000	$6.68x10^{-01}$	$3.10x10^{+00}$	$2.05x10^{-01}$	$2.47x10^{-01}$	$2.20x10^{-01}$	$1.15x10^{+02}$
Cementer	100	4,000	$1.34x10^{+00}$	$6.20x10^{+00}$	$4.10x10^{-01}$	$4.94x10^{-01}$	$4.40x10^{-01}$	$2.30x10^{+02}$
Water truck	340	4,000	$4.54x10^{+00}$	$2.11x10^{+01}$	$1.39x10^{+00}$	$1.68x10^{+00}$	$1.50x10^{+00}$	$7.82x10^{+02}$
Total			**$4.56x10^{+01}$**	**$2.11x10^{+02}$**	**$1.40x10^{+01}$**	**$1.69x10^{+01}$**	**$1.50x10^{+01}$**	**$7.85x10^{+03}$**

[1] Hours are based on the type, capacity, and number of equipment and machines shown in **Table 3-4**.

Table 3-6 Total Hourly Criteria Pollutant Emissions from Engines for Each Phase (lb/hr)

Pollutant	Total	Construction	Operation	Reclamation
SO_2	5.8	1.9	2.9	1.0
NO_X	87.1	28.5	43.6	15.1
VOC	6.9	2.3	3.5	1.2
PM_{10}	6.2	2.0	3.1	1.1
CO	18.7	6.1	9.4	3.2
CO_2	3,231.5	1,056.7	1,615.8	559.0

3.2.2 Hazardous Air Pollutants

HAPs are air toxics that pose the greatest threat to human health. HAPs emissions rates for the most common HAPs associated with fuel combustion are based on the following factors shown in **Table 2-4**.

HAP emission rates for each pollutant are below 1 ton per year, and the aggregate levels of all HAPs emissions are also less than 1 tons per year (tpy). **Table 3-7** lists the HAPs emitted from drill rigs, trucks, and pickups and **Table 3-8** shows annual HAPs emissions for each phase of the Project.

Table 3-7 HAP Emissions (tpy)

Equipment	Benzene	Toluene	Xylenes	Aceteldahyde	Formaldehyde	Propylene
Drill Rigs	$2.1x10^{-02}$	$9.2x\ 10^{-03}$	$6.4x\ 10^{-03}$	$1.7x\ 10^{-02}$	$2.7x\ 10^{-02}$	$5.8x\ 10^{-02}$
Heavy Trucks	$8.2x\ 10^{-04}$	$3.6x\ 10^{-04}$	$2.5x\ 10^{-04}$	$6.7x\ 10^{-04}$	$1.0x\ 10^{-03}$	$2.3x\ 10^{-03}$
Pickups	$2.0x\ 10^{-03}$	$8.6x\ 10^{-04}$	$6.0x\ 10^{-04}$	$1.6x\ 10^{-03}$	$2.5x\ 10^{-03}$	$5.4x\ 10^{-03}$

Table 3-8 Hazardous Air Pollutant Emissions by Phase (tpy)

Pollutant	Construction	Operation	Reclamation
Benzene	$1.95x10^{-02}$	$9.77x10^{-03}$	$1.69x10^{-03}$
Toluene	$8.56x10^{-03}$	$4.28x10^{-03}$	$7.41x10^{-04}$
Xylenes	$5.97x10^{-03}$	$2.98x10^{-03}$	$5.16x10^{-04}$
Aceteldahyde	$1.61x10^{-02}$	$8.03x10^{-03}$	$1.39x10^{-03}$
Formaldehyde	$2.47x10^{-02}$	$1.24x10^{-02}$	$2.14x10^{-03}$
Propylene	$5.40x10^{-02}$	$2.70x10^{-02}$	$4.67x10^{-03}$

3.3 Greenhouse Gases

Project GHG emissions were assessed as part of the air quality analysis. GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfurhexaflourides (SF_6).

Annual emissions of GHGs (CO_2 equivalents, or CO_2e, which include CO_2, methane, and N_2O) from construction and operations sources are directly related to the consumption of fuels (combustion). Purchased power also contributes to GHG emissions at the power plants that furnish power to the grid supplying power to the Project. **Table 3-9** shows the estimated GHG emissions for the Project from direct combustion of fossil fuels, dominated by diesel, but also including natural gas used for process heating and from indirect GHG emissions associated with electrical power consumption.

Table 3-9 Greenhouse Gas Production under the Proposed Action

Case	Diesel Consumption (gallons)	Natural Gas Usage (therms)	Power Consumption (MW-hours/year)	Diesel-related GHG (tpy) CO_2e	Natural Gas-related GHG (tpy) CO_2e	Indirect Power-related GHG (tpy) CO_2e	Total GHG (tpy) CO_2e
Proposed Action[1] (Stationary Sources)	0	546,942	9,746	0	3,014	4,207	7,221
Proposed Action (Mobile Sources)	19,746,935	--	0	219,191	--	0	219,191
Proposed Action Total	**19,746,935**	**546,942**	**9,746**	**219,191**	**3,014**	**4,207**	**226,412**

4.0 Air Quality Impacts

Impacts to air quality were analyzed by determining compliance with the AAQS for all criteria pollutants using SCREEN3. All pollutants were determined to have impacts less than AAQS and are deemed to not cause or contribute to a violation of the AAQS, and as such, no further refined modeling analysis was performed.

The AAQS are the maximum concentrations allowed in terms of total pollutant levels in ambient air. Compliance with the AAQS was based on the total estimated air quality concentrations, which is the sum of the following:

- Modeled impacts resulting from all project sources modeled at their proposed potential emission rates; and
- Background concentrations.

Although southwestern Wyoming experiences high levels of winter-time ozone, the region in the vicinity of the Gas Hills project is not expected to have ozone levels of concern, so ozone modeling was not conducted. The Project is a very minor source of NO_X, VOCs, or other ozone precursors. The Project is expected to be connected to grid-supplied electrical power to operate the injection and pumping wells required for the ISR processes.

4.1 Fugitive Dust

A generally accepted method of estimating fugitive dust emissions is to use a typical construction project. The average daily fugitive dust emissions for a typical construction project are estimated to be 1.2 tons PM_{10} per acre per month for construction activities (USEPA 1985). Use of this value is a generally accepted approach for impact analysis and is conservative, since Project construction would not involve demolition of existing structures and other activities with the potential to result in high short-term fugitive dust emissions.

Each truck was modeled as a volume source. The source of emissions is the truck wheel, but for the purposes of modeling, dimensions of 5.6 meters lateral and 1.5 meter vertical were set. This is a very conservative approach since all of the emissions start in a relatively small volume. The generic road segment used estimated a silt content of 5.1 percent and moisture content of 2.4 percent.

AECOM performed screening level dispersion modeling for each criteria pollutant. Since the screening modeling shows low impacts, well below National Ambient Air Quality Standards (NAAQS) levels, more refined modeling was not deemed necessary to demonstrate compliance with both the NAAQS and Wyoming Ambient Air Quality Standards, collectively referred to as AAQS.

Concentrations of PM_{10} estimated based on the conservative screening level dispersion modeling analysis for the Proposed Action are shown in **Table 4-1** and indicate that impacts due to fugitive dust emissions from roads and disturbed acres during Project construction would represent less than one percent of impacts allowable under National and State (AAQS).

Results of the conservative screening level dispersion modeling analysis for roads during the life of the Project for the Proposed Action are shown in **Table 4-2**, and indicate that the impacts from engines and road traffic would be well within the National and State AAQS.

Table 4-1 SCREEN3 Model Results for Construction Fugitive Dust from Construction

Pollutant	Averaging Time	Impact ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	National AAQS ($\mu g/m^3$)	Percent of National AAQS
PM_{10}	24-hour	0.8	10.2	11.0	150	7
	Annual	0.2	9	9.2	50	18
$PM_{2.5}$	24-hour	0.2	6.9	7.1	35	20
	Annual	0.1	2.6	2.7	15	17

Table 4-2 SCREEN3 Model Results for Fugitive Dust from Roadway Traffic

Pollutant	Averaging Time	Impact ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	National AAQS ($\mu g/m^3$)	Percent of National AAQS
PM_{10}	24-hour	39.9	10.2	50.1	150	33.4
	Annual	4.0	9	13.0	50	25.9
$PM_{2.5}$	24-hour	4.0	6.9	10.9	35	31.2
	Annual	0.4	2.6	3.0	15	19.9

Modeling results indicate that these activities would result in impacts that are well within allowable concentrations under National AAQS.

Emissions of $PM_{2.5}$ in fugitive dust were assumed to be a fraction (10 percent) of the emissions of PM_{10}. For internal combustion engines all particulate emissions were assumed to be $PM_{2.5}$.

4.2 Combustion Impacts

Project construction would generate criteria pollutant emissions from fuel combustion during construction, operation, reclamation, and decommissioning activities. The primary pollutants emitted would be PM_{10}, $PM_{2.5}$, oxides of nitrogen (NO_X), CO, and sulfur dioxide (SO_2). These emissions potentially would impact air quality in the GHPA.

Air pollutant emissions due to Project operation would occur from hauling product, commuter traffic, and maintenance traffic activities along the project roads over the lifetime of the Project. Estimated maximum hourly air pollutant emissions from equipment used for project activities are shown in **Table 4-3**. Short term rates are used in the modeling to determine short term hourly and daily impacts.

Screening dispersion modeling using SCREEN3 also was performed to assess combustion emissions from truck and drill rig engines. Engines were modeled as volume sources using full meteorology and default values for mixing heights and anemometer heights. Impacts were assessed at a distance of 10 meters to 5,000 meters from the source in the analysis area.

Table 4-3 Estimated Maximum Hourly Air Pollutant Emissions from Project Activities

Maximum Hourly Emission Rate (lb/hr)			
Pollutant	**Construction**	**Operations**	**Decommissioning / Reclamation**
SO_2	3.5	1.7	0.6
NO_x	52.3	26.1	8.7
VOC	4.2	2.1	0.7
PM	3.7	1.9	0.6
CO	6.1	9.4	3.2

[a] Emission estimates do not include commuter vehicle emissions. Emissions are estimated based on the type, capacity, and number of equipment and machines listed in **Table 3-4**.

[b] Emissions of particulate matter from combustion sources are estimated to be identical for PM_{10} and $PM_{2.5}$.

Results of the conservative screening level dispersion modeling analysis for engines are shown in **Table 4-4**, and indicate that the impacts from engines and road traffic would be well within the National and State AAQS.

Emissions would result in minor, short-term impacts on local air quality that would be restricted to the construction period. The construction impacts would diminish as a result of reclamation activities that would continue for two to three years after construction was completed and disturbed areas were reclaimed. Best management practices would be used to minimize impacts. Vehicular exhaust and crank case emissions from gasoline and diesel drivers would comply with applicable USEPA mobile emission regulations (40 CFR 85).

Table 4-4 SCREEN3 Model Results for Combustion Emissions from Engines

Pollutant	Averaging Time	Impact ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	National AAQS ($\mu g/m^3$)	Percent of National AAQS
SO_2	1-hour	1.1	NA	1.1	196	0.6
	3-hour	1.1	NA	1.1	700	0.2
SO_2	24-hour	0.5	NA	0.5	365	0.1
	Annual	0.0	NA	0.0	80	0.0
NO_2	1-hour	12.1	NA	12.1	188	6.4
	Annual	0.5	NA	0.5	100	0.5
PM_{10}	24-hr	0.5	10.2	10.7	150	7.1
	annual	0.0	9.0	9.0	50	18.0
$PM_{2.5}$	24-hr	0.1	6.9	7.1	35	20.1
	annual	0.0	2.6	2.6	15	17.2
CO	1-hour	3.5	NA	3.5	40,000	0.0
	8-hour	2.5	NA	2.5	10,000	0.0

4.3 Hazardous Air Pollutants

A discussion of HAPs emissions is included in Section 3.2.2 of this document. The primary sources of HAPs are internal combustion engines used to power construction equipment and vehicles. No HAPs modeling was performed for this project. No single HAP emission rate for the Project is near 10 tpy, nor are the aggregate levels near 25 tpy. Furthermore, mining is not one of the 70 listed NESHAP source categories which identify likely sources of HAPs.

4.4 Air Quality Related Values (AQRV)

Federal land managers responsible for managing Class I areas, such as wilderness areas and national parks, are concerned with potential impacts from nearby activities on air quality related values (AQRVs) such as visibility impairment, ozone effects on vegetation, and effects of pollutant deposition on soils and surface waters. For each of these areas of concern, Federal land managers' air quality guidance recommends that a screening test be applied for proposed sources greater than 50 km from a Class I area to determine whether or not any further analysis is necessary. No Class I areas are located less than 50 km from the GHPA. The screening test considers a source located greater than 50 km from a Class I area to have negligible impacts with respect to Class I AQRVs if its total SO_2, NO_X, PM_{10}, and H_2SO_4 annual emissions (in tons per year, based on 24-hour maximum allowable emissions), divided by the distance (in km) from the Class I area (Q/D) is 10 or less. Based on their guidance, Federal land managers would not request any further Class I AQRV impact analyses from such sources as impacts are anticipated to be negligible (USFS 2010).

The Project would not emit H_2SO_4; project annual emissions of SO_2, NO_X, and PM_{10} are used to derive the potential AQRV impacts as shown in **Table 4-5**. This approach provides a conservative analysis of potential impacts to Class I areas since it includes the pollutants of interest to the FLM, and is calculated using the highest 24-hour emission rates as if those highest emissions occurred every hour of the day for a full year.

Table 4-5 Estimated Annual Air Pollutant Emissions from Project Activities

Annual Emission Rate (tpy)[a]			
Pollutant	**Construction**	**Operations**	**Decommissioning/ Reclamation**
SO_2	8.4	4.2	1.4
NO_x	126.9	63.4	21.1
PM	9.0	4.5	1.5
Total	144.3	72.1	24.0

[a] Annual emissions (tpy) is based on the potential to emit at the highest hourly rates.

Class I AQRV analysis for Bridger NWA was performed using FLAG recommended analyses. The screening analysis is meant to provide a worst-case maximum impact estimate. The results of the screening analysis show compliance with existing regulatory requirements, so no further modeling for compliance with FLM standards is required.

The nearest Class I area is the Bridger Wilderness located about 80 miles (128 km) west of the project area. The Q/D test is calculated based on 144.3 tpy total emissions divided by 95 km resulting in a ratio of 1.1, which is well below 10; therefore, impacts to AQRVs from the Project are anticipated to be negligible and no further AQRV analysis is required.

4.5 Greenhouse Gasses

The scope of climate change is global, and is linked globally to the burning of fossil fuels for electricity, manufacturing, and transportation; deforestation and land surface change; agricultural and livestock operations; and fugitive methane emissions associated with pipelines and coal/oil/natural gas production.

The cumulative effects generally attributed to increased atmospheric greenhouse gas levels include, but are not limited to, melting permafrost, sea level rise, changing global climate patterns, redistribution of plant and animal species, redistribution of disease vectors, and altered precipitation regimes both spatially and temporally. Current state of the science does not have the ability to link any particular instance of greenhouse gas emissions or sequestration to any specific climate-related environmental effects.

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Appendix F

Wyoming Reclamation Policy

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82009-1828

IN REPLY REFER TO:
3042 (921Gamper) P

March 27, 2012

EMS TRANSMISSION: 4/2/2012
Instruction Memorandum No. WY-2012-032
Expires: 9/30/2013

To: District Managers and Deputy State Directors

From: Associate State Director

Subject: Wyoming Bureau of Land Management (BLM) Reclamation Policy

Program Areas: All Surface Disturbing Activities.

Purpose: Implement the Wyoming Reclamation Policy

Policy/Action: In order to ensure a consistent and science-based approach to reclamation, this Instruction Memorandum (IM) identifies ten reclamation requirements (see Attachments) that must be addressed when developing reclamation proposals for all surface disturbing activities. Addressing these ten requirements will help achieve both short and long-term reclamation success for site stabilization and eventual ecosystem reconstruction. The Wyoming Reclamation Policy was previously issued under IM No. WY-2009-022 which expired on September 30, 2010. This IM replaces IM No. WY-2009-022.

Background: Successful reclamation efforts are critical in maintaining an effective multiple-use land management program. Nearly all authorizations for surface disturbing actions are based upon the assumption that an area can and ultimately will be successfully reclaimed. Those seeking approval to conduct surface disturbing activities on Public Lands must include reclamation planning as part of their permit process and the BLM must make this requirement clear early in the permitting process. This IM applies to all BLM authorized actions including those initiated by the BLM.

Timeframe: Effective immediately.

Budget Impact: Savings to Project funds in the long-term.

Manual/Handbook Sections Affected: This IM will be supported with more detailed guidance including new reclamation bond standards and a statewide monitoring and reporting strategy.

Specific reclamation information, sample templates for both reclamation and weed management plans, and other technical guidance is posted on the Wyoming Reclamation web site (http://www.blm.gov/wy/st/en/programs/reclamation.html).

Coordination: The coordination and review of the Wyoming Reclamation Policy has been completed with the WY BLM Reclamation Team: Brenda Neuman, Mining Engineer, WSO; Ken Henke, Natural Resource Specialist, WSO; Adrienne Pilmanis, Botanist, WSO; Travis Bargsten, Physical Scientist, WSO; and Merry Gamper, Physical Scientist, WSO Lead. Other non-Wyoming BLM specialists, WO-310, the Wyoming Governor's Office (for review by all appropriate State Agencies), the University of Wyoming, some local Governments, and numerous interested reclamation professionals in private industry statewide.

Contact: Merry Gamper at 307-775-6272, and by e-mail at MGamper@BLM.gov.

Signed By:	Authenticated By:
Ruth Welch	Sherry Dixon
Associate State Director	Secretary

2 Attachments

1 - Wyoming BLM Reclamation Policy (6 pp)
2 - Wyoming BLM Oil and Gas Reclamation Plan Template (4 pp)

Distribution

Director (200), Rm. 5644, MIB 1	1 (w/o atch)
Director (300), Rm. 5625, MIB 1	1 (w/o atch)
Field Managers	1 (w/atch)
CF	1 (w/atch)

Wyoming Reclamation Policy

The Wyoming Reclamation Policy is guidance for the modification, preparation and/or review of all reclamation plans. It applies to all Federal actions authorized, conducted, or funded by the BLM that disturb vegetation and/or the mineral/soil resources. This policy is intended to be support all BLM program objectives.

A reclamation plan shall be developed for all surface disturbing activities and will become part of the proposed action in the NEPA document. The level of detail for the reclamation plan shall reflect: the complexity of the project, the environmental concerns, the reclamation potential for the site, and the re-vegetation strategy. These plans shall also incorporate any program or regulatory specific requirements for reclamation. The reclamation plan shall address short term stabilization to facilitate long term reclamation. The reclamation plan is considered complete when all the reclamation requirements described below have been addressed, the techniques to meet the reclamation requirements are described in detail, and the BLM concurs with the reclamation plan.

Many landscapes can be reclaimed using established conventional reclamation methods. However, some areas have unique characteristics that make achieving all the reclamation requirements described in this policy unrealistic. Innovative techniques beyond conventional practices must be considered and applied to reclaim these more challenging areas. Areas posing the most extreme reclamation challenges will be identified as having Limited Reclamation Potential (LRP). These areas are often characterized by highly sensitive and/or erosive soils, highly sensitive vegetation types, soils with severe physical or chemical limitations, extremely steep slopes, etc. These LRP areas may require site-specific reclamation measures not specifically addressed in the Wyoming Reclamation Policy. Each Field Office shall develop a unique set of reclamation success requirements for those areas within the framework of the attached Policy. The additional difficulty of reclaiming these LRP areas should be considered in the Resource Management Plan and evaluated when planning surface-disturbing activities. During the NEPA process, alternatives to approving development activities in LRP areas should be carefully analyzed. Alternatives considered should include: avoidance and/or unconventional site specific reclamation requirements. Resource development activities approved in these areas may require additional bonding.

A. RECLAMATION GOALS

1. Short term goal: immediately stabilize disturbed areas and provide conditions necessary to achieve the long term goal.

2. Long term goal: facilitate eventual native plant community and ecosystem reconstruction to maintain a safe and stable landscape and meet the desired outcomes of the land use plan.

B. RECLAMATION REQUIREMENTS

The following Reclamation Requirements apply to all surface disturbing activities, including BLM initiated activities, and must be addressed in each reclamation plan. These requirements also must be met prior to release of the bond and/or the reclamation liability. Where these Reclamation Requirements differ from other applicable Federal laws, rules, and regulations, those requirements supersede this policy. State and/or local statutes or regulations may also apply.

1. **Manage all waste materials:**

   a. Segregate, treat, and/or bio-remediate contaminated soil material.

   b. Bury only authorized waste materials on site. Buried material must be covered with a minimum of three feet of suitable material or meet other program standards.

   c. Ensure all waste materials moved off-site are transported to an authorized disposal facility.

2. **Ensure subsurface integrity, and eliminate sources of ground and surface water contamination.**

   a. Properly plug all drill holes and other subsurface openings (mine shafts, adits etc.).

   b. Stabilize, properly back fill, cap, and/or restrict from entry all open shafts, underground workings, and other openings.

   c. Control sources of contamination and implement best management practices to protect surface and ground water quality.

3. **Re-establish slope stability, surface stability, and desired topographic diversity.**

   a. Reconstruct the landscape to the approximate original contour or consistent with the land use plan.

   b. Maximize geomorphic stability and topographic diversity of the reclaimed topography.

   c. Eliminate highwalls, cut slopes, and/or topographic depressions on site, unless otherwise approved.

   d. Minimize sheet and rill erosion on/or adjacent to the reclaimed area. There shall be no evidence of mass wasting, head cutting, large rills or gullies, down cutting in drainages, or overall slope instability on/or adjacent to the reclaimed area.

4. **Reconstruct and stabilize water courses and drainage features.**

   a. Reconstruct drainage basins and reclaim impoundments to maintain the drainage pattern, profile, and dimension to approximate the natural features found in nearby naturally functioning basins.

   b. Reconstruct and stabilize stream channels, drainages, and impoundments to exhibit similar hydrologic characteristics found in stable naturally functioning systems.

5. **Maintain the biological, chemical, and physical integrity of the topsoil and subsoil** (where appropriate).

   a. Identify, delineate, and segregate all salvaged topsoil and subsoil based on a site specific soil evaluation, including depth, chemical, and physical characteristics.

   b. Protect all stored soil material from erosion, degradation, and contamination.

   c. Incorporate stored soil material into the disturbed landscape.

   d. Soil storage piles to be stored beyond one growing season, should be seeded with appropriate vegetation (native or sterile non-native species).

   e. Identify stockpiles with appropriate signage.

6. **Prepare site for revegetation.**

   a. Redistribute soil materials in a manner similar to the original vertical profile.

   b. Reduce compaction to an appropriate depth (generally below the root zone) prior to redistribution of topsoil, to accommodate desired plant species.

   c. Provide suitable surface and subsurface physical, chemical, and biological properties to support the long term establishment and viability of the desired plant community.

   d. Protect seed and seedling establishment (e.g. erosion control matting, mulching, hydro-seeding, surface roughening, fencing, etc.)

7. **Establish desired self-perpetuating native plant community.**

   a. Establish species composition, diversity, structure, and total ground cover appropriate for the desired plant community.

b. Enhance critical resource values (e.g. wildlife, range, recreation, biodiversity, etc.), where appropriate, by augmenting or accelerating restoration of plant community composition, diversity, and/or structure.

c. Select genetically appropriate and locally adapted native plant materials (e.g. locally sourced or cultivars recommended for seed zone) based on the site characteristics and ecological setting.

d. Use locally sourced and/or collected seeds to the extent possible (local collection and logistics should be included in the Reclamation Plan).

e. Select non-native plants only as an approved short term and non-persistent (i.e. sterile) alternative to native plant materials. Ensure the non-natives will not hybridize, displace, or offer long-term competition to the endemic plants, and are designed to aid in the re-establishment of native plant communities.

8. **Reestablish a complementary visual composition**

a. Ensure the reclaimed landscape features blend into the adjacent area and conform to the land use plan decisions.

b. Ensure the reclaimed landscape does not result in a long term change to the scenic quality of the area.

9. **Manage Invasive Plants**

a. Assess for invasive plants before initiating surface disturbing activities.

b. Develop an invasive plant management plan.

c. Control invasive plants utilizing an integrated pest management approach.

d. Monitor invasive plant treatments.

10. **Develop and implement a reclamation monitoring and reporting strategy.**

a. Conduct compliance and effectiveness monitoring in accordance with a BLM (or other surface management agency) approved monitoring protocol.

b. Evaluate monitoring data for compliance with the reclamation plan.

c. Document and report monitoring data and recommend revised reclamation strategies.

d. Implement revised reclamation strategies as needed.

e. Repeat the process of monitoring, evaluating, documenting/reporting, and implementing, until reclamation goals are achieved.

GLOSSARY

Contamination - The presence of man-made chemicals or other alterations in the natural soil or water environment (pesticides, hazardous substances, petroleum, salts).
Adapted from various sources

Desired Outcome*:* Specific goal/objectives and allowed uses outlined in land use plans. Desired outcomes should be identified for and pertain to resources (such as natural, biological, and cultural), resource uses, (such as energy and livestock grazing), and other factors (such as social and economic conditions).
BLM Handbook H-1601-1

Ecosystem **-** Includes all the organisms of an area, their environment, and the linkages or interactions among all of them; all parts of an ecosystem are interrelated. The fundamental unit in ecology, containing both organisms and abiotic environments, each influencing the properties of the other and both necessary for the maintenance of life.
Vegetation Treatments Using Herbicides in 17 Western States, Programmatic Environmental Impact Statement (BLM 2007)

Federal Action - Approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities.
National Environmental Policy Act (NEPA) [42 U.S.C. 4321 et seq.]

Invasive Plant **-** A species that is not native (or is alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Plants listed on the State of Wyoming, Designated Noxious Weed List, would be included under this definition.
Executive Order 13112, Invasive Species (1999)

Limited Reclamation Potential (LRP) - Areas possessing unique landscape characteristics (e.g., sensitive geologic formations, extremely limiting soil conditions, biological soil crusts, badlands, rock-outcrops, etc.) often make reclamation success impractical and/or unrealistic due to physical, biological, and/or chemical challenges. When disturbed, these areas may require unconventional reclamation strategies to address the ten requirements established by this Policy.
Adapted from various sources

Locally-sourced native plant materials - seeds, seedlings, transplants, and/or inocula obtained and/or increased from collection at the project location or from nearby similar sites.

Adapted from various sources including the Integrated Vegetation Management Handbook 1740-2, Ch. 8, and Johnson et al 2010 "What Are The Best Seed Sources For Ecosystem Restoration on BLM and USFS Lands?", Native Plants, 11:2:117-131

Reclamation Plan – The Reclamation Plan is a written document that addresses the reconstruction of disturbed ecosystems by returning the land to a stable and productive condition compatible with the land use plan. The Plan must address all ten requirements included in this Policy.
Adapted from various sources

Scenic Quality – The overall impression of a landscape retained after driving or walking through, or flying over an area. The Scenic Quality of an area is rated as Class A (outstanding visual characteristics), Class B (combination of outstanding and common visual characteristics), and Class C (common visual characteristics). See BLM Handbook H-8410 Visual Resource Inventory and BLM Handbook H-8431Visual Resource Contrast Rating.

Soil – A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthly parent material, as conditioned by relief over periods of time.
Glossary of Soil Science Terms

Subsoil – Technically, the subsoil includes the B horizon. This is roughly, the part of the solum below the organic topsoil and above the rocky parent material of the C horizon. When suitable, the subsoil may be salvaged to supplement the topsoil for plant establishment.
Adapted from various sources

Soil Material – Includes the topsoil and/or the topsoil and a portion of the subsoil salvaged and separated to be used to provide a growth medium for plant establishment.
Adapted from various sources

Surface Disturbing Activities – An action that alters the vegetation, surface/near surface soil resources, and/or surface geologic features, beyond natural site conditions and on a scale that affects other Public Land values. Examples of surface disturbing activities may include: operation of heavy equipment to construct well pads, roads, pits and reservoirs; installation of pipelines and power lines; and the conduct of several types of vegetation treatments (e.g., prescribed fire, etc.). Surface disturbing activities may be either authorized or prohibited.
Wyoming Information Bulletin 2007-029, Guidance for Use of Standardized Surface Use Definitions

Surface Management Agency –Any Federal or State agency having jurisdiction over the surface estate. *Adapted from Onshore Oil and Gas Order No. 1*

Topsoil – The biologically active, upper part of the soil profile, being the most favorable material for plant growth.
Adapted from U.S.D.A., Natural Resources Conservation Service

Waste materials – Any discarded or abandoned material that can interfere with successful reclamation, safety, and long term stability of a site (contaminated soil or water, drilling mud, solid waste). *Adapted from various sources*

Wyoming-BLM Reclamation Policy
Suggested Reclamation Plan Template for Oil and Gas Operations

I. Reclamation – Baseline Information

Site Description
- Climate/Precipitation/Ecological Site Description (ESD)
- Orientation/Aspect
- Existing land use(s)
- Surface and groundwater hydrology
- Topography/Relief

Soils Description
- Soil features
- Soil stripping and stockpiling (length of time and storage configuration)
  - Soil map (optional, but highly recommended on large locations or those exhibiting different micro-communities)
- Viability management
- Soil inhibiting factors
  - Management prescriptions/recommendations

Pre-Disturbance Vegetation Composition
- Photo log with locational information
- Species with density
  - Map (optional, but highly recommended on large locations or those exhibiting different micro-communities)
- Known weed infestations
  - Proposed treatment

II. Reclamation Objectives:

The objective of interim reclamation is to restore vegetative cover and a portion of the landform sufficient to maintain healthy, biologically active topsoil; control erosion; and minimize habitat, visual, and forage loss during the life of the well or facilities.

The long-term objective of final reclamation is to return the land to a condition approximating that which existed prior to disturbance. This includes restoration of the landform and natural vegetative community, hydrologic systems, visual resources, and wildlife habitats. To ensure that the long-term objective will be reached through human and natural processes, actions will be taken to ensure standards are met for site stability, visual quality, hydrological functioning, and vegetative productivity.

III. Reclamation Performance Standards

The following reclamation performance standards will be met:

Interim Reclamation – Includes disturbed areas that may be redisturbed during operations and will be redisturbed at final reclamation to achieve restoration of the original landform and a natural vegetative community.

- Describe “Success” Criteria

Final Reclamation – Includes disturbed areas where the original landform and a natural vegetative community have been restored.

Describe "Success" Criteria

IV. Reclamation Plan Requirements

1) Operator Contact/Responsible Official
   Project Title and Responsible Party
   Include existing leases/wells (for geographic field plan only)

2) Construction Control Actions (actions that will be taken to minimize erosion until Reclamation can begin):
   Stormwater and erosion control
   Slope stabilization
   Topsoil viability management
   Monitoring

3) Management of Invasive, Noxious, and Non-Native Species (Policy Section B9)
   Pre-disturbance presence/Treatment
   Invasive plant management plan
   Monitoring

4) Interim Reclamation
   a) Production-held Surfaces (Policy Sections B1, B2 and B3) (layout diagram)
      Stormwater and Erosion control
      Facility installation
      Housekeeping/Monitoring

   b) Pipelines located on-lease (Policy Sections B2 thru B8)
      Pressure testing and disposal (if applicable)
      Seeding Methods/Mix and Source
      Erosion Control measures
      Risers (location, work areas, safety barricades)

   c) Roads (Policy Sections B2 thru B9)
      Production running surface width
      Drainage/Erosion controls remaining
      Seeding methods/mix

   d) Pit Closure (Policy Sections B1, B2 and B3)
      Known contents
      Length of time pit has been/will be open
      Current pit problems (torn pit liner, non-RCRA materials, etc)
      Closure methodology
      Closure testing plan

Closure sample results submittal

e) Ancillary facilities closure (i.e. water wells, monitor wells, powerlines, fences, etc)

f) Site Preparation (i.e. Recontouring) (Policy Sections B2, B3, B4, B5 and B6)
Equipment
Methods
Suitable soil redistribution
Final recontour layout diagram

f) Establish desired self-perpetuating native plant community (Policy Section B7):
Application of Topsoil & Revegetation:
Seeding:

- Methods
- Schedule
- Seed Mix

Example Seed Mix Table

Species of Seed (Cultivar)	Seed Source (genetic source; distributor)	App. Rate PLS (lbs/ac)
		Total:

g) Visual Resources Mitigation (Policy Section B8)
Actions
Final goal description

h) SME Notification Procedure

i) Reclamation Monitoring (Policy Section B10)
Methods and Reporting
Erosion control

j) Invasive Weeds (Policy Section B9)

k) Additional Measures proposed to enhance “success” (ie irrigation, fertilization, fencing, etc)

5) Final Reclamation Procedures – Additional (Policy Sections B1-B10)

a) Facility Removal

Facilities to be removed
Site assessment clearance (spills, trash)

b) Roads

Road proposed to remain? (two track, fully constructed, none)
Removal of surface materials
Road bed preparation
Seeding methods, timing, and mix

c) Pipeline Decommissioning

Pipeline abandonment procedure
Seeding methods, timing, and mix (if necessary)

d) Ancillary facilities decommissioning (water wells, powerlines, monitoring wells, fences, etc.)

e) Additional Site Prep (pad, road, pipeline)

Source of soil materials (if necessary)
Additional dirt work/Recontouring
Final recontour layout diagram
Final surface drainage
Seeding methods, timing and mix

f) Reclamation Monitoring (pad, road, pipeline)

Methods and reporting
Erosion control

g) Invasive weed management

h) Final abandonment approval timeline

Appendix G

Gas Hills Transportation Plan

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10. **Vehicle Traffic Pattern Within Mine Units** 9

The following is a description of the transportation requirements needed for startup, operation, and decommissioning of the Gas Hills in-situ uranium mine to be operated by Cameco Resources, Inc. (Cameco). The plan covers a 25 year mine life expectancy. It is important to note, that the detailed design work has not been completed for the Gas Hills facility at this time. As a result, certain aspects of the design are presently unknown and cannot be detailed.

1. Transportation of Operating Personnel

For operation of the Gas Hills Satellite Facility; technical, operational, and management personnel will be necessary. Cameco anticipates that 80% of the staff will be travelling from the Riverton, Wyoming area while the remaining 20% will travel from the Casper, Wyoming area. The Gas Hills Satellite Facility is estimated to require an average of 46 personnel daily throughout the life of mine.

Transportation to and from the facility will be provided by the employees. Cameco assumes that several vehicle types will be utilized, including cars, sport utility vehicles and/or pickups. The percentage of cars, sport utility vehicles and/or pickups is unknown. The occupancy for each vehicle is estimated to be 1.6 persons per vehicle.

The transportation route to Riverton, Wyoming is:

- Gas Hills Facility to Gas Hills Road (unpaved road) 9 miles
- Gas Hills Road to Riverton, Wyoming (paved road) 46 miles

The transportation route to Casper, Wyoming is:

- Gas Hills Facility to Gas Hills Road (unpaved road) 7 miles
- Gas Hills Road to US 20-26 (unpaved road) 25 miles
- US 20-26 to Casper, Wyoming (paved road) 47 miles

The annual mileage and traffic data for this section is provided on Table 1 below.

Table 1. Transportation of Operations Personnel

Route	Average Employees / Day	Pickup Truck Vehicles / Year	Unpaved Mileage / Round Trip	Paved Mileage / Round Trip	Total Unpaved Mileage	Total Paved Mileage
[1]Riverton, Wyoming to/from Gas Hills Facility	37	8,440	18	92	151,920	776,480
[2]Casper, Wyoming to/from Gas Hills Facility	9	2,053	64	94	131,392	192,982

1 - Assumes that 80% of staff based out of Riverton, Wyoming

2 - Assumes that 20% of staff based in Casper, Wyoming

2. Drilling Contractors Supporting the Mine Operations

The mine operation will require contract drilling support. Cameco anticipates an average of 14 drill rigs annually will be on-site, for the life of the mine. Quarterly maintenance in Riverton, Wyoming is also accounted for in the estimate. The drill rig will be supported by a water truck, a pipe truck, and a transport truck for the drill crew. Occasionally a mechanic's truck may be needed.

It is anticipated that the drilling operations will be supported from the Riverton, Wyoming area. Once on-site, it is estimated that the drill rig and pipe truck will accumulate an average of 5 miles per day on unpaved roadway within the permitted boundary. The water truck will accumulate about 20 miles daily on unpaved roadways within the permitted boundary. Each

drilling rig will have a transport truck which the crew will travel to and from the mine site each day.

The vehicle traffic associated with this section is provided in Table 2 below.

Table 2. Drilling Supporting the Operating Plan

Vehicle Type	Number of Vehicles / Day	Average Annual Unpaved Mileage	Average Annual Paved Mileage
[1]Drill Rig	14	5,255	10,511
[1]Pipe Truck	14	5,255	10,511
[2]Water Truck	14	39,415	10,511
[3]Transport Truck	14	49,925	241,743
Miscellaneous	N/A	2,000	5,000

1 -5 miles per day per vehicle plus additional mileage for quarterly maintenance

2 - 15 miles per day per vehicle plus additional mileage for quarterly maintenance
3 - Each crew traveling from Riverton, Wyoming to the mine site and back to Riverton, Wyoming daily. Additional trips included for unforeseen rig breakdown
Assume on average 16 drilling days per month.

3. Construction Traffic

Initial construction of the mining infrastructure, process buildings, and evaporation ponds will take place beginning in 2013 and will be completed within a year. Additional construction to bring online added throughput capacity will occur in 2018. This construction effort is anticipated to be complete within one year. There will be no 'construction season' for work as construction is anticipated through every month of the year. It is expected that there will be short term deliveries of heavy equipment, concrete, piping, and a pre-fabricated administration building associated (within existing disturbed areas) with initial construction. For the duration of construction, it is anticipated an average daily crew size of 12 people will be transported from Riverton, Wyoming to the facility. This average accounts for peak construction periods anticipated to be on the order of about 40 people (for a short duration), as well as minimum size construction crews (possibly as few as 4 people). The following

table outlines the anticipated traffic during the construction phase of the project for years 2013 and 2018 only.

Table 3. Construction Personnel and Deliveries

Vehicle Type	Number of Vehicles / Day	Average Annual Unpaved Mileage	Average Annual Paved Mileage
[1]Equipment and Product Deliveries	1	6,000	27,600
[2]Transport Truck	4	18,000	110,400

1 -20 miles per day unpaved mileage per delivery. Included concrete trucks; heavy equipment deliveries, pre-fabricated building delivery; piping deliver; and other equipment deliveries.

2 - Each crew traveling from Riverton, Wyoming to facility daily. 46 paved mileage per day for each crew and 15 miles unpaved.

Assumes 300 days per year construction window.

4. Operations Support

Personnel will be required for water sampling, well casing, wellfield services, wellfield construction, maintenance, safety, and geology. Crew travel to the facility is covered under Section 1 of this plan. Once on-site, the crews will travel within the permit boundary with company vehicles to perform necessary tasks. The roadways within the permit boundary are primary and secondary roadways or two-tracks. The Revised Plan of Operations, Section 6.0 '*Description of Operations*' should be referenced for details.

In addition to the above operations support for processing through to resin, the facility will require deliveries of sodium bicarbonate, carbon-dioxide, oxygen, hydrochloric acid and propane. It is estimated to support resin operation that on an annual basis, approximately 50 deliveries of these materials will be needed. To support processing from resin through to slurry, the facility will also require deliveries of sodium carbonate, sodium chloride, caustic soda and sulfuric acid. It is estimated that to support slurry operation, an additional 60 deliveries of materials will be needed. Additionally, a commercial delivery service (FedEx,UPS), on the order of three deliveries per week, will be required to support the

operations as well as waste transportation on the order of one shipment per week. The following table provides annual traffic for the operations supply support personnel and deliveries.

Table 4. Operation Supply Support	
Average Annual Unpaved Mileage (RESIN ONLY)	15,269
Average Annual Paved Mileage (RESIN ONLY)	88,315
Average Annual Unpaved Mileage (SLURRY OPTION – INCLUDES MILEAGE FOR RESIN)	19,109
Average Annual Paved Mileage (SLURRY OPTION – INCLUDES MILEAGE FOR RESIN)	93,955

5. Slurry Transport

Current plans indicate that uranium could be processed at Gas Hills to slurry. Slurry will be trucked from Gas Hills and be delivered to the licensed Highland Resin Transfer System (Highland). Once the slurry is received at the Highland facility, the slurry is dried and packaged for shipping. Empty slurry transport trucks will be returned to the Gas Hills site.

The average annual production for the Gas Hills facility is anticipated to be about 1,100,000 pounds. Based on the average annual production it will require about 122 truckloads per year of slurry to be transported from the Gas Hills facility to Highland.

The transportation route for slurry will be:

- Gas Hills Facility to Gas Hills Road (unpaved road) 7 miles
- Gas Hills Road to US 20-26 (unpaved road) 25 miles
- US 20-26 to Casper, Wyoming (paved road) 47 miles
- Casper, Wyoming to Glenrock, Wyoming (paved road) 27 miles
- Glenrock, Wyoming to JCT HWY 95/93 (paved road) 22 miles
- JCT 95/93 to Highland Loop Road (paved road) 9 miles
- Highland Loop Road to Highland facility (gravel road) 5 miles

The following table provides the annual estimated vehicular traffic and mileage anticipated for this process.

Table 5. Slurry Transport

Annual Round-Trips	Average Unpaved Vehicle Mileage	Paved Vehicle Mileage
122	12,810	25,620

Slurry transport has previously been analyzed by the Nuclear Regulatory Commission. In the event that road passage is impossible with heavy equipment, storage capability will be built into the Carol Shop Satellite facility capable of storing up to 7 days of slurry. Should roads remain impassable by heavy trucks beyond that, road maintenance crews will be contracted to open roads and provide safe passage to the Highland Facility.

6. Resin Transport

Current plans indicate that uranium could be processed at Gas Hills to resin. Resin will be trucked from Gas Hills and delivered to the licensed Highland Resin Transfer System (Highland). Once received at the Highland facility the resin is processed into slurry; dried and packaged for shipping. Empty resin transport trucks will be returned to the Gas Hills site.

The average annual production for the Gas Hills facility is anticipated to be about 1,100,000 pounds. Based on the average annual production it will require about 325 truckloads per year of resin to be transported from the Gas Hills facility to Highland.

The transportation route for resin will be:

- Gas Hills Facility to Gas Hills Road (unpaved road) 7 miles
- Gas Hills Road to US 20-26 (unpaved road) 25 miles
- US 20-26 to Casper, Wyoming (paved road) 47 miles
- Casper, Wyoming to Glenrock, Wyoming (paved road) 27 miles

- Glenrock, Wyoming to JCT HWY 95/93 (paved road) 22 miles
- JCT 95/93 to Highland Loop Road (paved road) 9 miles
- Highland Loop Road to Highland facility (gravel road) 5 miles

The following table provides the annual estimated vehicular traffic and mileage anticipated for this process.

Table 6. Resin Transport

Annual Round-Trips	Average Unpaved Vehicle Mileage	Paved Vehicle Mileage
325	34,125	68,250

Resin transport has previously been analyzed by the Nuclear Regulatory Commission. In the event that road passage is impossible with heavy equipment, storage capability will be built into the Carol Shop Satellite facility capable of storing up to 7 days of resin. Should roads remain impassable by heavy trucks beyond that, road maintenance crews will be contracted to open roads and provide safe passage to the Highland Facility.

7. Emergency Snow Removal

Cameco will be purchasing a motorgrader as part of its mobile equipment fleet. The motorgrader will be used to maintain roads during periods of inclement weather, including removing snow. As previously discussed, the detail design engineering of the facility has not been completed. If there are emergency stores of chemicals or fuels, they will be within the existing disturbance limits of the facility (or potentially within the Carol Shop building itself).

8. Crew Shift

Shift work is currently planned to be on a 7:30 a.m. to 7:30 p.m. basis for operators every day of the week, 52 weeks a year. Professional and support staff will generally be on site Monday thru Friday from 7:30 a.m. to 4:00 p.m.

9. Vehicle Storage

There will be a parking lot at the Carol Shop facility for employee vehicles, company vehicles, and transport trucks. The definitive parking plans has not been developed, however there will be storage areas at the Carol Shop facility for slurry trucks, chemical trucks, delivery trucks, fuel trucks, ect., within existing disturbance limits.

10. Vehicle Traffic Pattern Within Mine Units

Cameco does not intend to build any main access roads to the individual well heads. Traffic to these sites will be minimal and will only incur for periodic maintenance (approximately once every 3 to 6 months). Maintenance to these sites will be performed during dry weather to deter damage (rutting). Cameco has established a plan that all roads and access follow a one way in/one way out policy. Each header house will have one established two-track road for entering and exiting the site.

Appendix H

Visual Contrast Rating Form

Form 8400-4
(September 1985)

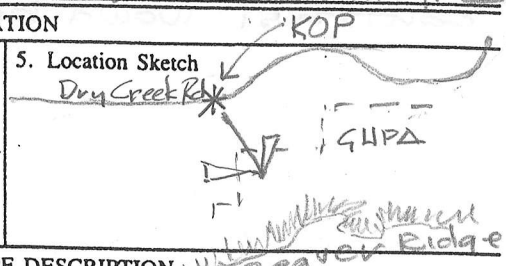
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date: 12/22/11
District: High Plains
Resource Area: Lander/Casper
Activity (program): In Situ Uranium Mine

SECTION A. PROJECT INFORMATION

1. Project Name: Gas Hills Uranium Project
2. Key Observation Point: Dry Creek Road
3. VRM Class: IV
4. Location
   Township: 32, 33N
   Range: 89, 90W
   Section: Multiple
5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	Flat to gently rolling, rising to rounded, irregular ridge (Beaver Div.)	Complex, irregular patterns of grasses & shrubs	Simple, large, rectangular w/gable roof.
LINE	Relatively simple horizontal, inclined to ridge	Generally diffuse, irregular; limited 2-track bands	Horizontal, curved, linear roads
COLOR	Light gray-beige soils, muted browns on slopes	Bright greens; blue greens, tans & beiges	Cream yellow; gray-beige unpaved roads
TEXTURE	Fine grained, regular	Fine to medium, uneven random	Fine to very fine

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	N.A.	Regular, grass & shrub forms in reclaimed areas	Rectangular & cylindrical
LINE	Simple, horizontal, banded irregular	Butt edged patterns becoming diffuse over time	Horizontal, mostly straight roads, t-lines, strong vertical t-line poles
COLOR	Gray-beige while disturbed	Bright spring greens, blue greens, tans, beiges	Desert tan; gray-beige roads
TEXTURE	Fine while disturbed	Fine to medium, ordered	Medium, even, ordered

SECTION D. CONTRAST RATING ☐ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

ELEMENTS	FEATURES: LAND/WATER BODY (1) Strong	Moderate	Weak	None	VEGETATION (2) Strong	Moderate	Weak	None	STRUCTURES (3) Strong	Moderate	Weak	None
Form				X			X				X	
Line			X			X				X		
Color			X				X			X		
Texture			X				X			X		

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: B. Strom
Date: 12/28/11

SECTION D. (Continued)

Comments from item 2.

Well heads, roads, T-lines, etc. would attract attention, but would not dominate views. Line, color & textural contrast would be weak to moderate.

Additional Mitigating Measures (See item 3)