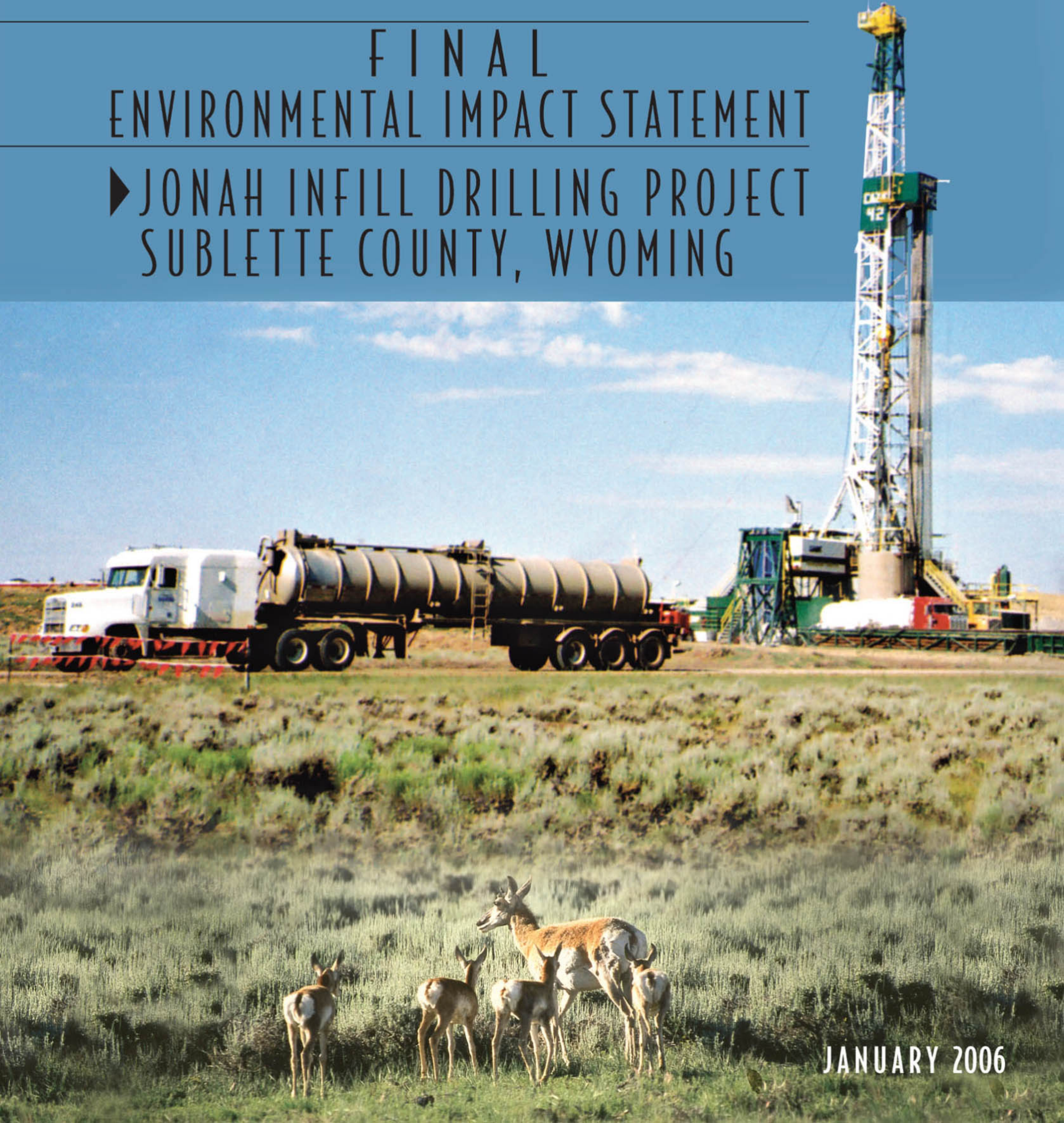
U.S. Department of the Interior

Bureau of Land Management
Pinedale and Rock Springs Field Offices

VOLUME 1 of 2

FINAL ENVIRONMENTAL IMPACT STATEMENT

JONAH INFILL DRILLING PROJECT SUBLETTE COUNTY, WYOMING



JANUARY 2006

BLM Document No.:
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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82003-1828

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In Reply Refer To:

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Dear Reader:

This Final Environmental Impact Statement (FEIS) for the proposed Jonah Infill Drilling Project (JIDP) is submitted for your review and comment. The FEIS has been prepared to provide a basis for the Bureau of Land Management (BLM) to decide whether to approve additional infill drilling in the Jonah Field, and if so, what approach balances all resources uses to the best advantage. This document has been prepared to analyze the potential impacts of the drilling and production operations of natural gas wells and associated access roads, pipelines, and production facilities proposed by several companies within the project area located in Sublette County, Wyoming.

Three technical support documents (TSDs) have also been prepared in conjunction with the FEIS. These documents contain detailed technical information for (1) air quality modeling, (2) socio-economic modeling, and (3) development procedures, including a transportation plan, reclamation plan, and hazardous materials management plan. The air quality modeling and socio-economic analysis TSDs are available upon request; the development procedures are included as an appendix to this document. The documents are also available for review at the BLM offices listed below. In addition, the FEIS and the TSDs may be viewed or downloaded from the BLM website at http://www.wy.blm.gov.

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

Bureau of Land Management
Pinedale Field Office
432 E. Mill Street
P.O. Box 768
Pinedale, Wyoming 82941

The Jonah Infill Drilling Project Area (JIDPA) includes approximately 30,500 acres with surface ownership at approximately 94 percent federal (28,580 acres), 2 percent (640 acres) and 4 percent State of Wyoming (1,280 acres). Currently within the JIDPA there are more than 500 producing and shut-in natural gas wells, and an extensive infrastructure of roads and pipelines for natural gas production.

Five alternatives have been analyzed in detail in this FEIS. The BLM determined that the additional five alternatives that had previously been analyzed in the Draft EIS do not warrant further consideration. The Proposed Action proposes to develop the natural gas resource by drilling up to 3,100 new wells on up to 16,200 acres of new surface disturbance over the next 12 years. To support gas field production, the Proposed Action includes development of infrastructure such as roads, pipelines, water wells, and other ancillary facilities needed to link the wells with existing transportations systems.

Under the No Action alternative, the effects of limiting development in the JIDPA to those that have been analyzed in previous environmental documents (Jonah Field II Natural Gas Project FEIS, 1998 and Modified Jonah Field II Natural Gas Project Environmental Assessment, 2000) are considered and provide a basis for comparison of alternatives.

Alternative A proposes to develop 3,100 new wells on up to 3,100 new well pads with the same additional infrastructure and time period as described for the Proposed Action. Certain lease stipulations and conditions of approval would not be included to facilitate recovery of natural gas. Alternative B also proposes to develop up to 3,100 new wells, but at a slower pace of development and within restriction of use of the current 497 well pads.

The Preferred Alternative proposes field development based on strict reclamation performance objectives, with a ceiling on the total percentage of surface disturbance within the JIDPA allowed at any one time. This alternative is the agency preferred alternative.

If you wish to submit comments on the FEIS, we request that you make them as specific as possible. Comments will be more helpful if they include suggested changes, sources, or methodologies. Comments that contain only opinions or preferences will not receive a formal response from the BLM. However, they will be considered and included as part of the BLM decision making process.

Comments will be accepted for thirty (30) days following the Environmental Protection Agency's (EPA) publication of its Notice of Availability in the Federal Register. Please send written comments to:

Mike Stiewig, Project Lead
Bureau of Land Management
Pinedale Field Office
P.O. Box 768
Pinedale, Wyoming, 82941

This FEIS was prepared pursuant to the National Environmental Policy Act and other regulations and statues to address the environmental and socio-economic impacts which could result from the project. This FEIS is not a decision document. Its purpose is to inform the public and interested agencies of impacts associated with implementing the proponents' drilling proposal, to evaluate alternatives to the proposal, and to solicit comments. This FEIS also provides information to other regulatory agencies for use in their decision-making process for other permits required for implementation of the project.

A copy of this FEIS has been sent to affected federal, state, and local government agencies, and to those persons who have indicated that they wish to receive a copy of the FEIS. Copies of the FEIS are available for public inspection at the BLM offices listed above.

If you have questions or need additional information, please contact Mike Stiewig, Project Lead, at the Pinedale Field Office, address shown above, or by phone (307) 367-5363.

Sincerely,

Robert A. Bennett
State Director

FINAL
ENVIRONMENTAL IMPACT STATEMENT
JONAH INFILL DRILLING PROJECT,
SUBLETTE COUNTY, WYOMING

(Volume 1 of 2)

Bureau of Land Management
Wyoming State Office
Cheyenne, Wyoming

Pinedale Field Office
Pinedale, Wyoming

and

Rock Springs Field Office
Rock Springs, Wyoming

January 2006

ABSTRACT

Environmental Impact Statement
Jonah Infill Drilling Project
Sublette County, Wyoming

( ) Draft (**X**) Final

Lead Agency:	Bureau of Land Management Pinedale Field Office Pinedale, Wyoming
Cooperating Agency:	State of Wyoming
For Further Information, Contact:	Mike Stiewig Bureau of Land Management 432 E. Mill Street P.O. Box 768 Pinedale, WY 82941 307-367-5300

The Bureau of Land Management has received a proposal from oil and gas developers to more intensively develop natural gas resources in an approximately 30,500-acre portion of the Jonah Field through infill drilling among existing wells. The project area is located approximately 32 miles southeast of Pinedale and 28 miles northwest of Farson in south-central Sublette County, Wyoming. Within the project area boundary there are currently more than 500 wells permitted and operating or committed to on 497 well pads. The wells are expected to produce for approximately 40 years, and the life of the project (i.e., the time from first well is drilled to the last well is plugged and abandoned, and habitat function restored) is estimated at up to 105 years.

Five alternatives were considered in detail. The No Action alternative is required by the National Environmental Policy Act (NEPA) as a baseline against which other action alternatives can be analyzed. For this project, the No Action alternative would not authorize field-level development, though drilling could continue on state and private leases and would occur on federal leases as authorized by prior NEPA decisions.

The Proposed Action includes drilling, completing, and operating up to 3,100 additional wells on up to 16,200 acres of new disturbance, including the roads, pipelines, and other ancillary facilities needed to support the new wells; minimum well pad (surface disturbance) density of 64 well pads per 640-acre section; bottomhole well density ranging from 1 bottomhole every 5 acres to 1 bottomhole every 40 acres; and 250 wells drilled per year. Standard field development and production procedures would be followed. Above a certain level of authorized surface disturbance, the Operators have committed to establishing a fund to finance compensatory (off-site) mitigation for impacts that cannot be fully mitigated within the project area.

One action alternative would remove certain standard restrictions, mitigations, and wildlife and surface protections to minimize the amount of directional drilling and facilitate additional gas recovery; another alternative would limit all drilling to the currently authorized 497 well pads.

The BLM Preferred Alternative combines aspects of these alternatives and applies additional mitigation and outcome- or performance-based field management objectives to ensure ongoing habitat restoration throughout the life of the project.

EXECUTIVE SUMMARY

The Department of Interior (DOI), Bureau of Land Management (BLM) Pinedale Field Office (PFO) and Rock Springs Field Office (RSFO) have received a proposal from EnCana Oil and Gas (USA), Inc., BP America Production Company, and other natural gas operators (collectively known as the Operators) to expand existing natural gas drilling and development operations in the Jonah Field in south-central Sublette County, Wyoming. Operations are proposed for that portion of the Jonah Field referred to as the Jonah Infill Drilling Project Area (JIDPA) which encompasses approximately 30,500 acres located in portions of Townships 28 and 29 North, Ranges 107 through 109 West, approximately 32 miles southeast of Pinedale and 28 miles northwest of Farson, Wyoming.

The DOI/BLM PFO and RSFO have determined the proposed project would constitute a major federal action and therefore requires the preparation of an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act of 1969, as amended (NEPA). This Final EIS (FEIS) replaces the Draft EIS (DEIS) in its entirety and was prepared in accordance with NEPA to assess the environmental consequences of the Operators' proposed action and alternative courses of action. It is intended to provide the public and decision-makers with a complete and objective evaluation of impacts that might occur from the Proposed Action and reasonable alternatives.

Life of project (LOP) is estimated to vary from 63 to 105 years, depending on the alternative and pace of development.

Currently within the JIDPA, BLM has approved or committed to 497 well pads with associated access roads, pipelines, and ancillary facilities. Operation and maintenance of these facilities will continue as authorized by existing permits.

PROPOSED ACTION

The Operators propose to expand development of natural gas and condensate reserves from the Lance and other formations at depths of approximately 11,000 feet by drilling as many as 3,100 additional wells on up to 16,200 acres of new surface disturbance during the development (drilling) phase. Specific features include the following: a minimum of 64 well pads per 640-acre section, downhole well spacing from 1 bottomhole/5 acres to 1 bottomhole/40 acres; up to 465 miles of new resource roads with associated pipelines; 8 miles of new collector/local roads; 41 acres of new surface disturbance for ancillary facilities; and 100 acres of new surface disturbance for exploration of other formations. The Operators have committed to various mitigation measures that vary by alternative and propose to fund compensatory or off-site mitigation (CM) under some alternatives. The CM fund could mitigate adverse impacts within the JIDPA by financing substitution mitigation projects outside the JIDPA. As proposed, the fund could be based on the level of surface disturbance authorized.

SCOPING

Public and agency scoping was conducted to determine issues relative to the Proposed Action. A scoping notice and informational materials were mailed to potentially interested parties beginning in March 2003. All issues identified during scoping and BLM and Interdisciplinary Team reviews were evaluated to identify key issues that drove development of alternatives and the impact analyses. The nine key issues identified are: surface disturbance acreage; socioeconomics and boom/bust avoidance; regional visibility effects; greater sage-grouse/greater sage-grouse habitat protection; pronghorn antelope migration corridor protection; direct and indirect habitat fragmentation and loss for all wildlife; maximum natural gas recovery; loss of livestock forage and project hazards; and BLM monitoring and enforcement capability.

The three action alternatives meet the Purpose and Need of the proposal but vary in response to the key issues. Some alternatives considered in depth in the DEIS have not been carried over to the FEIS. Other alternatives were considered but rejected for a variety of reasons.

ALTERNATIVES

No Action Alternative: Reject Operators' Proposal

The No Action Alternative would reject the Operators' Proposed Action and all field-level development alternatives. Though this alternative rejects the field-level development as proposed, previously approved drilling and drilling at spacing analyzed in previous NEPA documents could take place. An estimated 533 such wells that are not part of the current proposal have already been completed or are to be drilled in the study area. No Action Alternative serves as a benchmark enabling decision-makers and the public to compare the magnitude of environmental consequences across action alternatives.

Alternative A: Minimize Directional Drilling

New (drilling phase) surface disturbance would be comparable to the Proposed Action (16,200 acres), but development activity would be exempt from some existing BLM Conditions of Approval (COAs), stipulations, and mitigation. Most notably, environmentally sensitive areas would not be avoided in order to increase the gas recovered.

Alternative B: Minimize Surface Disturbance

All new wells would be drilled from the 497 currently approved well pads. This alternative requires expansion of existing well pads but results in the least amount of new surface disturbance (3,222 acres) while still providing for a higher level of resource recovery within the JIDPA.

BLM Preferred Alternative

The Preferred Alternative would limit total surface disturbance at any given time to 46% of the JIDPA, or a maximum of 14,030 acres. To mitigate environmental impacts as quickly as possible, Operators would be required to initiate reclamation of developed well pads pursuant to Reclamation Plan specifications. Credit would thereafter be given, on an acre-by-acre basis up to a maximum of 6,379 acres, for areas the BLM determines have successfully been reclaimed (i.e., achieved 80% indigenous vegetative basal cover/density and species composition). Under no circumstances would cumulative total surface disturbance exceed 20,334 acres over the LOP.

Performance-based field management objectives would address key issues and significant impacts, particularly those associated with air quality. Monitoring and surveying would be required to determine if objectives are being met. An interagency adaptive management working group would be established to monitor the effectiveness of development guidelines, mitigation, and monitoring, and to recommend to BLM any modifications to these procedures based on monitoring results.

ENVIRONMENTAL IMPACTS

Physical Resources Impacts

Topography/Water

The JIDPA has a continental, semi-arid, cold desert climate and is located in the central Green River Basin with ephemeral drainages primarily flowing to the Green or Big Sandy Rivers. Groundwater and surface water are variable in quality. Use of surface water from the JIDPA has been limited in the past due to the ephemeral nature of the surface stream system. Groundwater is taking an increasing role in both livestock watering and natural gas development operations. Significant impacts to topography are expected but not to groundwater resources. Surface water resources down-channel from the JIDPA could be affected by cumulative runoff events.

Paleontology

Paleontological resources are known to exist within the JIDPA and the surrounding cumulative impact assessment area. As such, the potential exists for direct impacts to unknown paleontological resources under all alternatives.

Air Quality/Visibility

Although, no violations of applicable federal or state air quality standards are anticipated, significant project-specific and cumulative air quality impacts to visibility are possible at regional Class I airsheds (e.g., Bridger Wilderness Area) are anticipated under all alternatives (including No Action). A summary of air quality impacts is presented in Tables 4.1 and 4.2, and a detailed analysis of air quality effects is provided in the *Final Air Quality Technical Support Document for the Jonah Infill Drilling Project Environmental Impact Statement*.

Soils

Seventeen soil map units occur in the JIDPA and most have construction and reclamation limitations. Several known sand dunes and other windblown deposits occur in the area. Significant impacts to soils (loss during runoff events, loss of productivity) could occur under all alternatives.

Biological Resources Impacts

Wildlife

Significant impacts to various wildlife habitats in the JIPDA have already occurred as a result of past and current oil and gas development activity. Wildlife that occurs in the JIPDA that may be impacted by this project include pronghorn antelope, greater sage-grouse, raptors, and up to 17 BLM Wyoming Sensitive (BWS) species (most notably sagebrush obligates). On-site mitigation measures and monitoring would occur under most alternatives pursuant to the Wildlife Monitoring/Protection Plan; however, additional significant impacts to some of these species are anticipated. On-site habitat function should be restored as reclamation vegetation nears maturity.

Threatened & Endangered Species

Threatened and endangered (T&E) species that may occur on or downstream from the JIDPA include the black-footed ferret, bald eagle, four Colorado/Green River fish species (Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker), and the plant Ute ladies'-tresses. Groundwater depletions may adversely affect the four endangered fishes, but no impacts are anticipated to the other T&E species.

Plant Cover

Plant cover values vary according to the three dominant sagebrush vegetation types present on the JIDPA, with significant impacts expected in many areas. To mitigate the potential impacts, a Reclamation Plan for the project has been prepared (see *Jonah Infill Drilling Project Development Procedures Technical Support Document*, Appendix B) and would be required for all development alternatives. Performance-based management objectives in the BLM Preferred Alternative would further mitigate impacts by focusing development and reclamation on faster restoration of pre-development plant cover.

Land Use Impacts

During the LOP and beyond, the JIDPA may not be as suitable for the historical land uses of livestock grazing, wildlife use, and recreation until facilities are removed, lands are reclaimed, and on-site habitat function is restored.

Cultural and Historic Resources Impacts

Potential impacts to cultural resources would be mitigated through data recovery and/or avoidance of significant properties. Site-specific surveys for cultural resources would be conducted prior to disturbance, and formal Wyoming State Historic Preservation Office (SHPO) consultation would occur where cultural resource properties may be impacted. If eligible cultural properties were inadvertently disturbed (unanticipated discoveries), appropriate data recovery programs would be implemented.

Socioeconomic Impacts

Communities most likely to be affected by the proposed project are Pinedale, Big Piney/Marbleton, and Boulder in Sublette County; La Barge in Lincoln County; and Eden/Farson and Rock Springs in Sweetwater County. A detailed socioeconomic impact assessment was prepared for this project (see *Socioeconomic Analysis Technical Support Document for the Jonah Infill Drilling Project Environmental Impact Statement*). Significant socioeconomic impacts have already occurred in these cities and counties, due in part to oil and gas development over the past decade. Beneficial impacts have included additional work opportunities, increased salaries, and increased government revenues. Increased population growth has resulted in adverse impacts, including increased demands on infrastructure, social services, emergency services, medical facilities, and housing availability, as well as increased crime that has burdened law enforcement organizations. JIDPA will have similar types of beneficial and adverse effects, but the additional impacts are not expected to be significant in scale.

MITIGATION MEASURES

Numerous standard, JIDPA-specific, and site-specific mitigation measures could be applied during all phases of the project to minimize potential impacts. Site-specific measures would be applied in approved Applications for Permit to Drill and Rights-of-Way applications for each new project feature as Conditions of Approval for mitigation or monitoring. Interim reclamation would restore any areas disturbed during initial development that are not required during the production phase for the LOP. Upon completion of the project, all wells would be plugged and abandoned, surface facilities would be removed, and the remaining disturbed areas (with the exception of certain road improvements) would be reclaimed and revegetated.

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ABBREVIATIONS AND ACRONYMS

ºF	Degrees Fahrenheit
µeq/l	Microequivalents per liter
µg	Micrograms
µg/m^3	Micrograms per cubic meter
AACL	Acceptable Ambient Concentration Levels
AASHTO	American Association of State Highway and Transportation Officials
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ADT	Average daily traffic
acre-ft	Acre-foot/feet
AGA	American Gas Association
AIRFA	American Indian Religious Freedom Act
AJE	Annual Job Equivalents
AML	Appropriate Management Level
ANC	Acid-neutralizing capacity
APD	Application for Permit to Drill
API	American Petroleum Institute
API	Atmospheric pressure ionization
AQD	Air Quality Division
AQRV	Air Quality-Related Values
ARPA	Archaeological Resource Protection Act of 1979
ARS	Agricultural Research Service
ATV	All-terrain vehicle
AUM	Animal unit month
BA	Biological Assessment
BACT	Best Available Control Technology
bbls	Barrels
BCF	Billion cubic feet
bcpd	Barrels of condensate per day
BLM	Bureau of Land Management
BMP	Best Management Practice
B.P.	Before present
BP America	BP America Production Company (formerly BP Amoco).
bpd	barrels per day
BTU	British Thermal Unit
BWS	Bureau of Land Management Wyoming Sensitive
BWPD	Barrels of Water Per Day
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CIAA	Cumulative impact assessment area
CM	Compensation Mitigation
CO	Carbon monoxide
CO_2	Carbon dioxide
COA	Condition of Approval
COOP	University of Wyoming Cooperative Fish and Wildlife Research Unit
COE	U.S. Army Corps of Engineers
CPI-U	Consumer Price Index for all Urban Consumers
CRMP	Cultural Resource Management Plan
CSU	Controlled Surface Use Stipulations
DAT	Deposition Analysis Threshold
dB	Decibel
dBA	A-weighted decibel
DEIS	Draft environmental impact statement
DM	Department Manual
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DR	Decision Record
dv	Deciview
EA	Environmental assessment
ED	Economically Disadvantaged
EIS	Environmental impact statement
EnCana	EnCana Oil and Gas (USA), Inc.
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCA	Energy Policy Conservation Act
ESA	Endangered Species Act
FAR	Functioning-at-risk
FEMA	Federal Emergency Management Agency
FLPMA	Federal Land Policy and Management Act of 1976
FONSI	Finding of No Significant Impact
FR	*Federal Register*
g/hp-hr	Grams per horsepower-hour
gal	Gallon
GCIAA	General Cumulative Impact Assessment Area
GDRA	Great Divide Resource Area

GIS	Geographic information system
gpm	Gallons per minute
GPS	Global positioning system
GRBAC	Green River Basin Advisory Council
GRRA	Green River Resource Area
GSP	Gross State Product
H_2S	Hydrogen sulfide
HAP	Hazardous air pollutant
hp	Horsepower
HS-20	Refers to the AASHTO truck type and axle load rating
HUD	Department of Housing and Urban Development
I-80	Interstate 80
IAMWG	Interagency Management Working Group
IDT	Interdisciplinary Team
IM	Instruction Memorandum
IMPROVE	Interagency Monitoring of Protected Visual Environments
IWAQM	Interagency Workgroup on Air Quality Modeling
JACRMA	Jonah-Anticline Cultural Resource Management Area
JIDPA	Jonah Infill Drilling Project area
JMHCAP	Jack Morrow Hills Coordinated Action Plan
JIO	Jonah Interagency Office
kg/ha-yr	Kilogram per hectare per year
LAC	Limit of Acceptable Change
lb(s)	Pound(s)
LCHMA	Little Colorado Herd Management Area
LOP	Life-of-Project
LQD	Land Quality Division
MBO	Million barrels of oil
mcf	Thousand cubic feet
MCIAA	Minerals Cumulative Impact Assessment Area
MEI	Maximally exposed individual
MFP	Management Framework Plan
mg	Milligram
MGD	Million gallons per day
MJ2PA	Modified Jonah II Project Area
MLE	Most likely exposure
mmcf	Million cubic feet
mmcfd	Million cubic feet per day
MOU	Memorandum of Understanding
mph	Miles per hour
MSDS	Material Safety Data Sheet
N_2	Nitrogen
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves and Repatriation Act
NCPA	National Cultural Programmatic Agreement
n.d.	No date
NED	Not Economically Disadvantaged
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NF	Nonfunctional
NO_x	Oxides of nitrogen
NO_2	Nitrogen dioxide
NOI	Notice of Intent
NOS	Notice of Staking
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NSO	No Surface Occupancy
NTL	Notice to Lessees
NWI	National Wetland Inventory
OHV	Off-highway vehicle
Operators	EnCana, BP America, and other oil and gas companies working in the JIDPA
OSHA	Occupational Safety and Health Administration
OVM	Organic vapor meter
PA	Programmatic Agreements
PAPA	Pinedale Anticline Project Area
PAWG	Pinedale Anticline Working Group
PFC	Proper functioning condition
PFO	Pinedale Field Office
PILT	Payment in lieu of taxes
PLS/ac	Pure live seed per acre
$PM_{2.5}$	Particulate matter less than 2.5 microns in effective diameter
PM_{10}	Particulate matter less than 10 microns in effective diameter
POD	Plan of Development
ppm	Parts per million
PRA	Pinedale Resource Area
PRBP	Powder River Basin Project
PSD	Prevention of Significant Deterioration
Pub. L.	Public Law
RCRA	Resource Conservation and Recovery Act of 1976
RDP	Road Development Plan
RFD	Reasonably Foreseeable Development
RMG	Reservoir Management Group
RMP	Resource Management Plan
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum

ROW	Right-of-way
RSFO	Rock Springs Field Office
RV	Recreational vehicle
RVD	Recreational visitor days
SARA	Superfund Amendments and Reauthorization Act of 1986
SCADA	Supervisory Control and Data Acquisition
SCBC	Sublette County Board of Commissioners
SCPC	Sublette County Planning Commission
SCS	U.S. Soil Conservation Service
SHPO	State Historic Preservation Office
SIL	Significant Impact Level
SMA	Surface Management Agency
SO_x	Oxides of sulfur
SO_2	Sulfur dioxide
SPCCP	Spill Prevention, Control, and Countermeasure Plan
SPSS	Special Status Plant Species
SRA	Sensitive resource area
SUP	Surface Use Plan
SVR	Standard visual range
SWPPP	Stormwater Pollution Prevention Plan
SWREE	Southwest Regional Economic Evaluation
T&E	Threatened and endangered
TCF	Trillion cubic feet
TCP	Traditional Cultural Properties
TCPU	Transportation, Communication, and Public Utilities
TDS	Total dissolved solids
TEC&SC	Threatened, endangered, candidate, and other species of concern
TEE	total energy efficiency
TEP&C	Threatened, endangered, proposed and candidate species.
THK	THK Associates, Inc.
TLS	Timing Limitation Stipulations
TMDL	Total Maximum Daily Load
TP	Transportation Plan
TPA	Transportation planning area
TPTSD	Transportation Planning Technical Support Document
TPQ	Threshold planning quantity
tpy	Tons per year
TRC Mariah	TRC Mariah Associates Inc.
TRPH	Total recoverable petroleum hydrocarbons
TSP	Total suspended particulate matter
USC	United States Code
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USDOC	U.S. Department of Commerce
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Fish and Wildlife Service
UW	University of Wyoming
USGS	U.S. Geological Survey
VOC	Volatile organic compounds
VRM	Visual Resource Management
WAAQS	Wyoming Ambient Air Quality Standards
WAPA	Wyoming Association of Professional Archeologists
WAQSR	Wyoming Air Quality Standards and Regulations
WCLI	Wyoming Cost of Living Index
WDA	Wyoming Department of Agriculture
WDEQ	Wyoming Department of Environmental Quality
WDERP	Wyoming Department of Employment, Research, and Planning
WDOC	Wyoming Department of Commerce
WDOE	Wyoming Department of Employment
WDOT	Wyoming Department of Transportation
WDR	Wyoming Department of Revenue
WESTAR	Western States' Air Resource Council
WGFC	Wyoming Game and Fish Commission
WGFD	Wyoming Game and Fish Department
WHHMA	Wild Horse Herd Management Area
WOGCC	Wyoming Oil and Gas Conservation Commission
WQD	Water Quality Division
WRCC	Western Regional Climate Center
WS	Wyoming Statute
WSA	Wilderness Study Area
WSEO	Wyoming State Engineer's Office
WSGS	Wyoming State Geological Survey
WSLUC	Wyoming State Land Use Commission
WSP	Wyoming State Protocol
WUS	Waters of the U.S.
WyCAS	Wyoming Comprehensive Assessment System
WyGISC	Wyoming Geographic Information Science Center
WyNDD	Wyoming Natural Diversity Database

CHAPTER 1 — INTRODUCTION

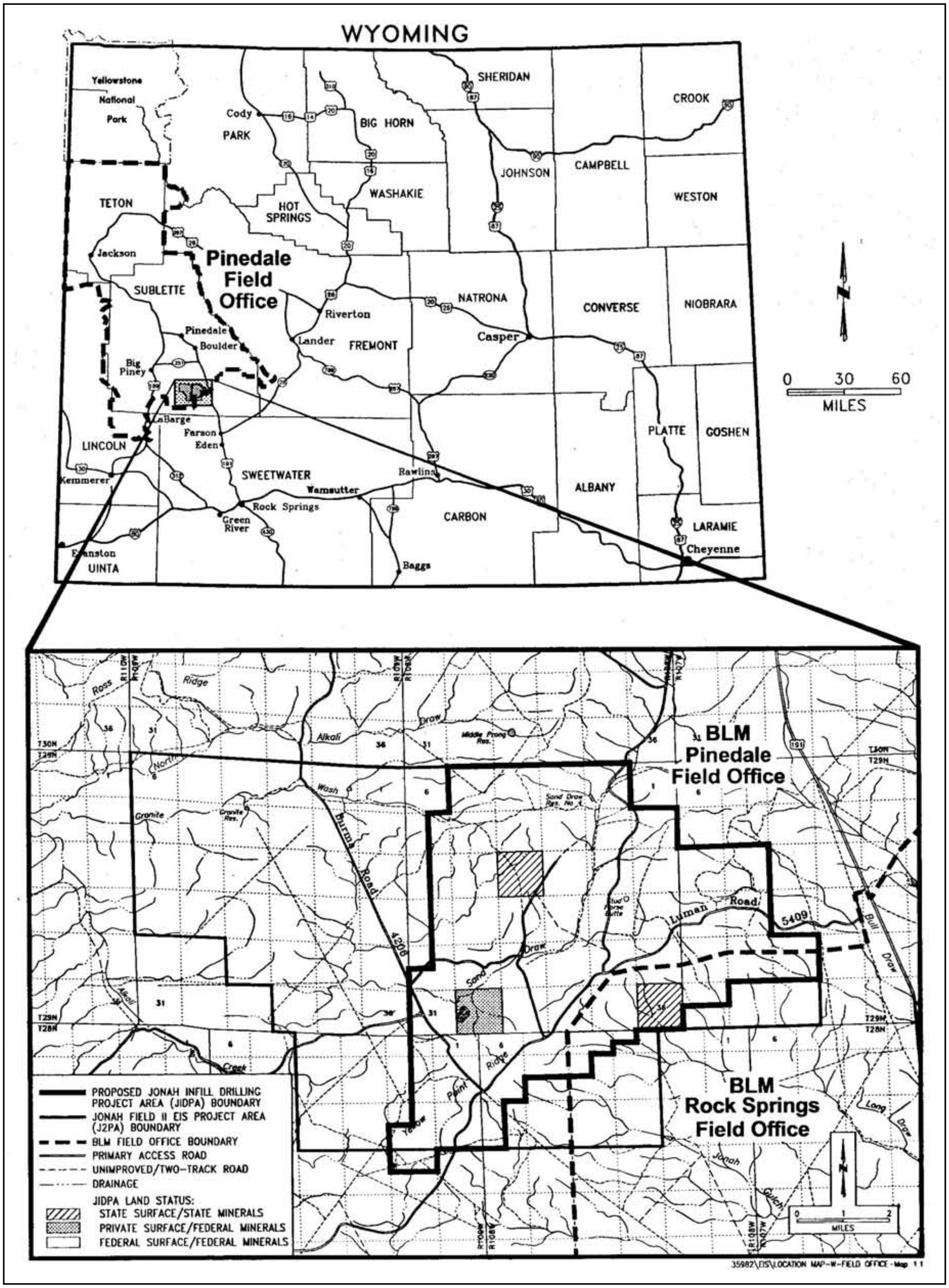
1.1 PROJECT LOCATION, SETTING, AND HISTORY OF PRIOR DEVELOPMENT

The U.S. Department of the Interior (USDI) Bureau of Land Management (BLM) Pinedale Field Office (PFO) and Rock Springs Field Office (RSFO) received a proposal from EnCana Oil & Gas (USA), Inc. (EnCana), BP America Production Company (BP America), and other companies (referred to as "Operators") to expand existing Jonah Field natural gas drilling and development operations in south-central Sublette County, Wyoming, approximately 32 miles southeast of Pinedale, 28 miles northwest of Farson, and 1.5 to 11.0 miles west of U.S. Highway 191 (Map 1.1). Expanded development is proposed in portions of Townships 28 and 29 North (T28N-T29N), Ranges 107, 108, and 109 West (R107-109W).

The project is referred to as the Jonah Infill Drilling Project (JIDP), and the total Jonah Infill Drilling Project Area (JIDPA) encompasses approximately 30,500 acres. This acreage includes approximately 28,580 acres of federal surface and mineral estate managed by the BLM, 1,280 acres of State of Wyoming surface and minerals, and 640 acres of private surface/federal minerals. The JIDPA includes the entire area formerly described as the Modified Jonah Field II Project Area (BLM 2000a), but for analysis purposes has been expanded to include the N½ of Section 23, T28N, R109W, because natural gas development from the same productive formation occurs in this area.

Topography in the JIDPA and surrounding area is characterized by low, gently rolling hills interspersed with buttes; elevations range from approximately 7,000–7,400 feet above mean sea level. Vegetation consists primarily of Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*) communities. Characteristic fauna inhabiting the JIDPA and surrounding areas include pronghorn antelope (*Antilocapra americana*); greater sage-grouse (*Centrocercus urophasianus*); various raptor and passerine species; white-tailed prairie dog (*Cynomys leucurus*); and various hares, rabbits, ground squirrels, mice, rats, and voles. The JIDPA is intersected by numerous ephemeral washes, but contains no perennial water bodies and no known fish species; one large playa is located in Section 32, T29N, R108W, and numerous smaller playas and depressions are scattered throughout the project area. The Wind River Range is typically visible approximately 20 miles to the northeast and the Wyoming Range approximately 50 miles to the west. Precipitation throughout the area is meager, on average totaling only 8.0 inches per year.

The JIDPA is widely acknowledged to be one of the most highly concentrated, highly productive sweet natural gas fields in North America (Bowker and Robinson 1997; Surdam 2001; Gray et al. 2003). The field produces both natural gas and condensate (oil contained in the natural gas stream). Targeted producing strata lie primarily in the Lance Formation and the upper levels of the underlying Mesaverde Group, approximately 7,500–11,800 feet below ground surface. Operator estimates of original gas in place (OGIP) within these formations is at least 12,800 billion cubic feet (BCF), with recoverable volumes under the Proposed Action estimated at approximately 62% of that volume, or roughly 7,900 BCF; condensate recovery under the Proposed Action is estimated at 75.5 million barrels.



Map 1.1. Jonah Infill Drilling Project Location, Sublette County, Wyoming, 2006.

According to the Energy Information Administration (2004), 1 BCF of natural gas is the average annual amount used by 13,700 Wyoming households.

Existing natural gas drilling operations within the JIDPA have been previously authorized in the Jonah Field II Natural Gas Project Environmental Impact Statement (EIS) (BLM 1997a, 1998a) and its Record of Decision (ROD) (BLM 1998b), and subsequently revised by the Environmental Assessment (EA), Finding of No Significant Impact (FONSI), and Decision Record (DR) for the Modified Jonah Field II Natural Gas Project (BLM 2000a, 2000b). These decisions authorized surface disturbance from 497 well pads on 4,209 acres, including roads, pipelines, and other supporting facilities (see Table 2.3). The Proposed Action would entail a major expansion of these existing natural gas development operations.

1.2 OVERVIEW OF THE PROPOSED PROJECT

Based on Operator knowledge of natural gas reservoir characteristics (geology, flow from existing wells, anticipated recovery rates, and economics), the Operators anticipate field development in the JIDPA to involve infill drilling among existing wells. The Operators propose drilling and developing up to 3,100 additional new wells in the JIDPA depending on the outcome of continued exploration and reservoir characterization. Bottom-hole (subsurface) well spacing is expected to range from 16 wells per 640-acre section up to as many as 128 wells/section (1 well/5 acres). The Operators propose a minimum of 64 well pads per section. The construction of various ancillary facilities such as roads, pipelines, water wells, water disposal sites, and compressor station expansions would occur in association with the expanded development. Because the Operators have identified the potential for up to 3,100 new wells with associated facilities on up to 16,200 acres of new surface disturbance, BLM determined that preparation of an EIS was required to analyze the impacts associated with this level of development.

The Draft EIS (DEIS) for this proposed project, published in February 2005, assessed the estimated environmental impacts of the No Action Alternative, the Proposed Action, seven additional action alternatives, and the BLM Preferred Alternative (BLM 2005a). Subsequent public, agency, and Operator comments on the DEIS, in conjunction with analyses later conducted by BLM and extensive internal and interagency discussion, led BLM to eliminate from final analysis in this Final EIS (FEIS) five of the alternatives presented in the DEIS and to significantly revise its Preferred Alternative (see Chapter 2). The purpose of this FEIS is to provide the public decision-makers with sufficient information to understand the anticipated environmental consequences of implementing the project and to select a project alternative that will adequately meet the defined Purpose and Need (Section 1.3) within the context of BLM's broader management goals for all resources under its jurisdiction. Under any alternative, appropriate measures to minimize environmental impacts would be required; these will be stipulated in the project Record of Decision (ROD) and in later site-specific permitting actions.

Standard operating procedures and practices currently used in gas field development throughout Wyoming and the surrounding region would be employed for this project (see Appendix A, *BLM Standard Stipulation/Mitigation Requirements*, and Appendix B, *Development Procedures*). In addition, the Operators have committed to a range of standard, project-specific, and site-specific mitigation measures under various alternatives that would serve to further avoid, minimize, or mitigate potential environmental impacts (see Appendix C, *Operator-Committed Practices*). Construction, development, production, and abandonment would comply with all applicable federal, state, and county laws, rules, and regulations (see Section 1.5). Reclamation would be conducted as soon as practical on disturbed areas, frequently in conjunction with ongoing development elsewhere in the field. Upon project completion, all wells would be plugged and abandoned, surface facilities would be removed, and disturbed areas would be reclaimed and revegetated.

1.3 PURPOSE AND NEED FOR THE PROJECT

The proposed development meets the purpose and need of BLM Resource Management Plan (RMP) minerals development objectives. These objectives are:

- to maintain or enhance the opportunities for mineral exploration and development, while protecting other resource values;
- to provide for oil and gas leasing, exploration, and development while protecting other values;
- to consider the conservation and enhancement of natural resources with the economic benefits of resource development;
- to coordinate land use decisions with economic factors and needs;
- to plan land use consistent with the orderly development, use, and conservation of resources while preserving environmental quality; and
- to plan uses that encourage energy conservation.

The purpose of the proposed development is also to enable the commercial production by Operators of federally owned natural gas in conformance with BLM RMP oil and gas objectives, pursuant to their rights under existing oil and gas leases issued by the BLM, and to prevent drainage of federal minerals by wells located on adjacent non-federally owned lands (i.e., State of Wyoming lands). All of the federally owned minerals in the JIDPA have been leased. National mineral leasing policies and the regulations by which they are enforced recognize the statutory right of leaseholders to develop federal mineral resources to meet continuing national needs and economic demands as long as unnecessary and undue environmental degradation is not incurred.

According to the American Gas Association (2003), 99% of the natural gas used in the U.S. is produced in North America (85% in the U.S. and nearly 15% in Canada), supplies are abundant, and demand is anticipated to increase 45% by 2015 and 53% by 2020; this project would assist in providing natural gas to meet anticipated demand. Demand has increased 35% in the last decade. The National Petroleum Council (2003) estimates that natural gas provides nearly one-quarter of all U.S. energy requirements, about 19% of electric power generation, and is used for heating and cooking in over 60 million U.S. households. U.S. industries get over 40% of all their primary energy from natural gas.

Development of new gas resources like those proposed by the Operators in the JIDPA is consistent with the Comprehensive National Energy Strategy announced by the U.S. Department of Energy (DOE) in April 1998 (DOE 1998), the Energy Policy and Conservation Act (42 United States Code [USC] 6201), and the Energy Policy Act of 2005 (Public Law 109-58).

1.4 DECISIONS TO BE MADE

The decision BLM will make as a result of the analysis presented in this FEIS is whether to allow, and under what conditions to allow, the development, operation, maintenance, and reclamation of expanded development/surface disturbances on federal land in the JIDPA. BLM will determine what levels of impacts are approved, and what Conditions of Approval (COAs), Best Management Practices (BMPs), mitigation, monitoring, and surveying would be required.

The ROD associated with this FEIS will not be the final review or the final approval for all actions associated with this proposal. BLM must review and authorize each component of the project that involves the disturbance of federal lands on a site-specific basis. The method used to evaluate and authorize each surface-disturbing activity is normally an Application for Permit to Drill (APD), right-of-way (ROW) grant, or Sundry Notice, with supporting environmental record of review, which would be required before any construction can occur.

1.5 REGULATORY SETTING

This EIS incorporates key provisions of Federal Land Policy and Management Act of 1976 (FLPMA) to manage public lands and their resource values to "best meet the present and future needs of the American people" (Section 103 [43 USC 1702]) and to coordinate resource management "without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or greatest unit output" (Section 103 [43 USC 1702]). FLPMA also states that it is appropriate that some lands be used "for less than all of the resources" (Section 103 [43 USC 1702]). The proposed project is compliant with resource management regulations (43 Code of Federal Regulations [CFR] 1610).

The BLM PFO is the lead agency for this EIS because the vast majority of development is proposed for lands under their jurisdiction. The BLM (PFO and RSFO) has provided guidance, input, participation, and independent evaluation during EIS preparation. The State of Wyoming participated in the preparation of this EIS as a cooperating agency; state agencies specifically participating include the Office of State Lands and Investments, Wyoming Department of Environmental Quality (WDEQ), Wyoming Oil and Gas Conservation Commission (WOGCC), Wyoming State Geological Survey (WSGS), Wyoming State Engineer's Office (WSEO), Wyoming Department of Agriculture (WDA), Wyoming Game and Fish Department (WGFD), Wyoming State Historic Preservation Office (SHPO), Wyoming State Parks and Historic Sites, Wyoming Business Council, and Wyoming Department of Transportation. BLM, in accordance with 40 CFR 1506.5(a) and (c), is in agreement with the information and analyses presented in this EIS and approves and takes responsibility for the scope and content of this document.

This EIS was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA), as amended, the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500–1508), and is in compliance with all applicable regulations and laws subsequently passed, including USDI requirements (Department Manual [DM] 516 [516 DM 1 through 6, 11], *Environmental Quality* [USDI 2004]), guidelines listed in the BLM *National Environmental Policy Act Handbook, H-1790-1* (BLM 1988a), *Guidelines for Assessing and Documenting Cumulative Impacts* (BLM 1994c), Washington Office Instruction Memorandum (IM) 2005-247 *National Environmental Policy Act (NEPA) Compliance for Oil, Gas, and Geothermal Development*, and CEQ's *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997).

1.5.1 Federal Permits, Authorizations, and Coordination

Consistent with regulations regarding federal oil and gas leasing and operations (43 CFR Parts 3100 and 3160 respectively) oil and gas leases are issued by the BLM. Stipulations may be added as terms of a lease to reflect management guidance established in the applicable RMP.

Once the lease is issued, the leaseholder/operator must apply for and receive site-specific authorization(s) prior to drilling within the leasehold area. To meet required environmental obligations, the leaseholder/operator must submit to the BLM an APD or its associated application for ROW so that the appropriate environmental review may be prepared. Environmental documents such as EAs, Categorical Exclusion, or the appropriate environmental record of review for APD or ROW authorizations often include site-specific COAs that add further site-specific operation requirements. Drilling of federal minerals is subject to the BLM's Onshore Oil and Gas Orders (43 CFR Subpart 3164 – Special Provisions). BLM *Onshore Order Nos. 1* and *2* require an applicant to comply with the following conditions:

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

Onshore Order No. 1 specifically states that "lessees and operators shall be held fully accountable for their contractor's compliance with the requirements of the approved permit and/or plan" (48 *Federal Register* [FR] 56226, December 20, 1983).

Pipeline and road ROWs on federal lands would be issued under the authority of the Mineral Leasing Act of 1920 as amended or FLPMA. ROW grants authorizing construction of ancillary facilities, access roads, and pipelines would grant the Operators certain rights that are subject to the terms and conditions incorporated into the grant by BLM.

Nine Presidential Executive Orders (EOs) also affect implementation of the proposed project. These EOs, which are binding on all government agencies, place restrictions on government approval of construction activities and apply to wetlands (EO 11990), floodplains management (EO 11988), migratory birds (EO 13186), environmental justice (EO 12898), Native American sacred sites (EO 13007), historic trails (EO 13195), cultural resources and historic preservation (EO 11593 and EO 13287), and invasive species (EO 13112).

The BLM also has specific provisions it must adhere to regarding the draining of federal minerals from adjoining nonfederal lands. These provisions are codified in 43 CFR 3100.2, which states that, upon determination that lands owned by the U.S. are being drained of oil or gas by wells drilled on adjacent lands, the BLM may execute agreements with the owners of adjacent lands whereby the U.S. and its lessees shall be compensated for such drainage. In addition, where lands in any lease are being drained of their oil and gas content by wells either on another federal lease, issued at a lower rate or royalty, or on nonfederal lands, the lessee shall both drill and produce all wells necessary to protect the lease lands from drainage. In lieu of drilling necessary wells, the lessee may, with the consent of the BLM, pay compensatory royalty. These provisions are also incorporated in the lease terms contained in all federal oil and gas leases (Form 3100-11).

A list of the major permits, approvals, and authorized actions necessary to construct, operate, maintain, and abandon project facilities is provided in Table 1.1.

Table 1.1. Major Federal, State, and Local Permits, Approvals, and Authorizing Actions for the Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Agency	Permit, Approval, or Action	Authority
Office of the President of the United States	Protection and enhancement of the cultural environment	Executive Order 11593
	Floodplains management	Executive Order 11988
	Protection of wetlands	Executive Order 11990
	Environmental justice	Executive Order 12898
	Indian sacred sites	Executive Order 13007
	Invasive species	Executive Order 13112
	Protection of migratory birds	Executive Order 13186
	Trails for America in the 21st century	Executive Order 13195
	Preserve America	Executive Order 13287
Bureau of Land Management (BLM)	Permit to drill, deepen, or plug back on federal onshore lands (Application for Permit to Drill [APD]/Sundry process); authorization for flaring and venting of natural gas on federal lands; plugging and abandonment of a well on federal lands	Mineral Leasing Act of 1920 (30 United States Code [USC] 181 et seq.); 43 Code of Federal Regulation (CFR) 3162
	Right-of-way (ROW) grants and temporary use clearances on federal lands	Mineral Leasing Act of 1920, as amended (30 USC 185); 43 CFR 2880; Federal Land Policy and Management Act (FLPMA) (43 USC 1761–1771); 43 CFR 2800
	Antiquities and cultural resource clearances on BLM-managed land	Antiquities Act of 1906 (16 USC Section 431–433); Archaeological Resources Protection Act of 1979 (16 USC Sections 470aa–470ll); Preservation of American Antiquities (43 CFR 3)
	Approval to dispose of produced water on BLM-managed land	Mineral Leasing Act of 1920 (30 USC 181 et seq.); 43 CFR 3164; Onshore Oil and Gas Order No. 7
U.S. Army Corps of Engineers (COE)	Section 404 permits and coordination regarding placement of dredged or fill material in area waters and adjacent wetlands	Section 404 of the Clean Water Act of 1972 (40 CFR 122-123, 230)
U.S. Fish and Wildlife Service (USFWS)	Coordination, consultation, and impact review on federally listed threatened and endangered (T&E) species	Fish and Wildlife Coordination Act (16 USC Sec. 661 et seq.); Section 7 of the Endangered Species Act of 1973, as amended (16 USC et seq.); Bald Eagle Protection Act, as amended (16 USC 668–668dd)

Table 1.1. (Continued)

Agency	Permit, Approval, or Action	Authority
U.S. Environmental Protection Agency (EPA)	Spill Prevention, Control, and Countermeasure Plans (SPCCPs)	40 CFR 112
	Regulation of hazardous waste treatment, storage, and/or disposal	Resource Conservation and Recovery Act (42 USC 6901)
U.S. Department of Energy (DOE)	Regulation of interstate pipeline product transportation	Various sections of the USC and CFR
U.S. Department of Transportation (DOT)	Control of pipeline maintenance and operation	49 CFR 191 and 192
Wyoming Board of Land Commissioners/ Land and Investments Office	Approval of oil and gas leases, ROWs for long-term or permanent off-lease/off-unit roads and pipelines, temporary use permits, and developments on state lands	Wyoming Statute (WS) 37-1-101 et seq.
Wyoming Department of Environmental Quality - Water Quality Division (WDEQ/WQD)	Regulation of off-lease disposal of drilling fluids from abandoned reserve pits	Wyoming Environmental Quality Act (WS 35-11-301 through 35-11-311)
	National Pollutant Discharge Elimination System (NPDES) permits for discharging waste water and stormwater runoff	WDEQ Rules and Regulations, Chapter 18, Wyoming Environmental Quality Act (WS 35-11-301 through 35-11-311); Section 405 of the Clean Water Act (40 CFR 122–124)
	Administrative approval for discharge of hydrostatic test water	Wyoming Environmental Quality Act (WS 35-11-301 through 35-11-311)
Wyoming Department of Environmental Quality - Air Quality Division (WDEQ/AQD)	Permits to construct and permits to operate	Clean Air Act; Wyoming Environmental Quality Act (WS 35-11-201 through 35-11-212)
Wyoming Department of Environmental Quality - Land Quality Division (WDEQ/LQD)	Mine permits, impoundments, and drill hole plugging on state lands	Wyoming Environmental Quality Act, Article 4, and Quality, as amended (WS 35-11-401 through 35-11-437)
Wyoming Department of Environmental Quality - Solid Waste Division	Construction fill permits and industrial waste facility permits for solid waste disposal during construction and operations	Wyoming Environmental Quality Act (WS 35-11-501 through 35-11-520)
Wyoming Department of Transportation (WDOT)	Permits for oversize, overlength, and overweight loads	Chapters 17 and 20 of the Wyoming Highway Department Rules and Regulations
Wyoming Oil and Gas Conservation Commission (WOGCC)	Permit to use earthen pit (reserve pits) on nonfederal lands	WOGCC Regulations (Section III; Rule 305)
	Authorization for flaring or venting of gas	WOGCC Regulations (Section III; Rule 326)
	Permit for Class II underground injection wells	WOGCC Regulations (Section III; Rule 346)

Table 1.1. (Continued)

Agency	Permit, Approval, or Action	Authority
Wyoming Oil and Gas Conservation Commission (WOGCC), continued	Well plugging and abandonment	40 CFR 146; 40 CFR 147.2551
	Permit to drill, deepen, or plug back (APD process)	WOGCC Regulations (Section III; Rule 315)
	Change in depletion plans	Wyoming Oil and Gas Act (WS 30-5-110)
	Minimum safety standards for oil and gas activities	WOGCC Regulations (Rules 320-A, 327, and 328)
Wyoming State Engineer's Office (WSEO)	Permits to appropriate groundwater (use, storage, wells, dewatering)	WS 41-121 through 147 (Form U.W.5)
	Permits to appropriate surface water	WS 41-201 (Form S.W.1)
Wyoming State Historic Preservation Office (SHPO)	Cultural resource protection, programmatic agreements, consultation	Section 106 of National Historic Preservation Act (NHPA) and Advisory Council Regulations (36 CFR 800)
Sublette County	County road crossing/access permits	Planning and Zoning Department
	Small wastewater permits	Planning and Zoning Department
	Hazardous material recordation and storage	Emergency Management Coordinator
	Zone changes	Planning and Zoning Department
	Noxious weed control	Weed and Pest Department

1 This list is intended to provide an overview of the key regulatory requirements that would govern project implementation. Additional approvals, permits, and authorizing actions may be necessary.

1.5.2 Wyoming BLM Mitigation Guidelines and Practices for Surface Disturbing and Disruptive Activities

The Wyoming BLM has adopted a standard set of guidelines and post-lease COAs that apply to all surface-disturbing activities on federal lands and minerals in Wyoming (see Appendix A). These mitigation guidelines encompass all aspects of environmental protection. Upon request by the applicant, an exception to a lease stipulation or a COA may be granted by the BLM following on-site review to see if the exception is warranted.

With the exception of specific mitigations excluded from Alternative A (see Chapter 2), the standard Wyoming BLM mitigation guidelines are applied to all alternatives analyzed in this EIS.

1.5.3 Conformance with BLM Pinedale and Green River Resource Management Plans

Policies for development and land use decisions within the JIDPA are contained in the draft and final Pinedale Resource Area (now referred to as the PFO) RMP/EIS (BLM 1987a, 1987b), its ROD (BLM 1988b), and the Green River Resource Area (now referred to as the RSFO) RMP/EIS (BLM 1992a, 1996a) and its ROD (1997b). These two RMPs allocate which lands and/or minerals are appropriate for leasing. These documents also provide development guidelines. Both RODs indicate federal minerals will be made available for orderly and efficient development, and all minerals actions will comply with goals, objectives, and resource restrictions (mitigations) required to protect other resource values. Both the PFO and RSFO planning areas (excluding specific locations outside the JIDPA) are open to consideration for exploration, leasing, and development for all leaseable minerals (e.g., oil, gas, coal).

The alternative selected and approved for the JIDP must be in conformance with the PFO and RSFO RMPs. The PFO RMP states that Preferred Alternatives would be considered in conformance if they: (1) are specifically provided for in the plan, (2) are consistent with the provisions, guidelines, and objectives of the plan, or (3) are not specifically prohibited or are not inconsistent with objectives and other actions that are provided for in the plan. The Preferred Alternative must meet at least one of these requirements in all aspects of its implementation to be in conformance with the PFO RMP. The RSFO RMP simply states that "All public land and resource uses in the planning area must conform with the decisions, terms, and conditions of use" described in the RMP. BLM has determined that the Preferred Alternative for the JIDPA complies with the applicable decisions, terms, and conditions of use in the RSFO RMP.

The Notice of Intent (NOI) for this EIS (see Section 2.1) indicated the possible need for an amendment to the PFO RMP as a result of proposed new well drilling and surface disturbance. However, an amendment would not be needed so long as the approved alternative remains in conformance with the RMP's objectives. BLM has determined that the proposed project is in conformance with the RMP's objectives, and therefore does not require an amendment of the PFO RMP as updated by the ROD for the Pinedale Anticline Oil and Gas Exploration and Development Project (BLM 2000c) if development at the proposed level were approved.

Specifically, the proposed project is in conformance with the overall fluid minerals management objectives of the PFO and RSFO RMPs, even though it partially exceeds estimates of reasonably foreseeable development (RFD) in the PFO RMP (as updated in BLM 2000c). The Pinedale Anticline ROD set an oil and gas RFD projection of 1,944 new wells (above the 1,815 wells present at that time) over a 10- to 15-year period beginning in 2000, and included 6,300 acres of new long-term disturbance (above the 14,076 acres present at that time). As of March 2004, the WOGCC website listed 2,530 wells in the PFO area; these wells are estimated to require approximately 8,572 acres of long-term disturbance. Current oil and gas development proposals in the PFO could add approximately 3,310 more wells (more than the updated RFD) and 5,190 acres of new long-term disturbance (less than the updated RFD). Though this exceeds the RFD for number of new wells, the BLM considers long-term surface disturbance as the governing objective. Under this management strategy, existing RMP objectives would still be met.

It should be noted that projections of RFD are based upon the best data available at the time and the professional judgment of the estimators. Although considerable effort is put forth in developing these estimates, actual development may differ from the projections. However, any approved alternative must continue to comply with key elements of the RMPs (i.e., areas prohibited from surface disturbance continue to remain withdrawn, long-term surface disturbance objectives are met, and only areas previously opened for development are included in the JIDPA) or include actions necessary to update and/or amend the plan. In addition, reasonable stipulations must be implemented to reduce or eliminate adverse impacts resulting from the development. Thus, although the project may not be consistent with RFD projections for number of new wells, it remains in conformance with the overall fluid minerals management objectives of the RMPs.

The air quality management objectives set forth in the RMPs state that air quality would be maintained at present levels or enhanced where possible. It also notes the BLM would try to minimize, within the scope of its authority, any emissions that may add to existing impacts.

Existing field development has already caused some impacts to air quality in the JIDPA, so the baseline conditions for implementation of the current proposal no longer meet those present when the PFO RMP was developed. Nevertheless, air quality in the Pinedale area remains excellent. It should be noted that agencies with responsibility and authority for regulating air quality include the Environmental Protection Agency and the State of Wyoming Department of Environmental Quality. Current modeling predicts that existing levels of emissions may cause some visibility impacts outside of the JIDPA boundary. However, the BLM will implement various mitigations that will require a reduction in project-specific air quality impacts over the life of the project compared to development stage levels. This will meet the RMPs' objective of minimizing those air quality impacts that are within the BLM's authority to regulate.

The wildlife management objective of the PFO RMP is to maintain sufficient habitat to support wildlife populations at the 1987 WGFD planning objective levels, as updated in 2004 to reflect more recently available data. However, well spacing authorized prior to 2004 has resulted in adverse impacts to some species. To mitigate the additional impacts of infill drilling, the Operators have proposed off-site mitigation aimed at habitat enhancement linked to various levels of authorized surface disturbance (see Chapter 5). This off-site mitigation would also meet the objectives of the RSFO RMP, which include improving or enhancing biological diversity while providing for wildlife needs. Considering the existing conditions in the project area, incorporation of off-site mitigation in the selected alternative would result in a positive impact to wildlife in the area. Three of the four action alternatives presented in Chapter 2 (i.e., the Proposed Action, Alternative A, and the Preferred Alternative) would include extensive provisions for off-site mitigation aimed at habitat enhancement as part of the project and are therefore considered in conformance with the wildlife management objectives of the RMPs because such mitigation would help achieve the intent of those objectives.

1.5.4 State and Local Permits, Authorization, and Coordination

The proposed project development alternatives are in conformance with the *Wyoming State Land Use Plan* (Wyoming State Land Use Commission 1979) and the *Sublette County Comprehensive Plan: County Vision, Goals and Policies* (Sublette County Board of Commissioners [SCBC] and Sublette County Planning Commission [SCPC] 2003). The alternatives comply with all relevant state and county laws and regulations (see Table 1.1).

CHAPTER 2 — ALTERNATIVES

2.1 PUBLIC PARTICIPATION AND IDENTIFICATION OF KEY ISSUES

2.1.1 Public Scoping

NEPA regulations (40 CFR 1500–1508) require the BLM to use an early scoping process to identify significant issues in preparation for impact analysis. The principal goals of scoping are to allow public participation and identify issues, concerns, and potential impacts that require detailed analysis in the EIS. Scoping was the primary mechanism used by the BLM to identify public interests and concerns about proposed development actions in the JIDPA.

To encourage early and improved public participation and agency cooperation, a number of meetings/announcements involving the BLM, Operators, various agencies, and the public have been held. On March 13, 2003, the BLM's Notice of Intent (NOI) appeared in the *Federal Register* and invited the public to comment or provide research information regarding the Operators' proposal to infill drill in the Jonah natural gas field. On March 26, 2003, copies of a scoping notice describing the Proposed Action and seeking comments were mailed to appropriate government offices, elected officials, public land users, groups, newspapers, and radio and television stations. A scoping meeting was held in Pinedale, Wyoming, on April 17, 2003. An additional public meeting was held on November 13, 2003, to present to the public the draft project alternatives that had been developed to address public concerns and would be analyzed in the EIS. At the request of the BLM, on November 20, 2003, EnCana and BP jointly submitted to the BLM a revised development proposal. On December 12, 2003, the BLM issued a letter identifying Operator-proposed development plan revisions and soliciting further comment. This letter was issued to those who received the March 2003 scoping notice and other parties who had commented in response to the NOI.

Numerous issues and concerns were identified and comments were submitted between March 2003 and August 2004. Consultation and coordination with other government agencies included the Wyoming Game and Fish Department (WGFD), U.S. Fish and Wildlife Service (USFWS), U.S. Department of Agriculture Forest Service (USFS), Environmental Protection Agency (EPA), WDEQ, and the BLM Interdisciplinary Team (IDT). The issues and concerns identified during this period are summarized in Section 2.1.2 and presented in detail in Appendix D.

All comments received during the scoping process were reviewed and analyzed. The BLM identified nine key or driving issues based primarily upon the assumed quantity, intensity, or duration of a potential impact, and/or the volume of agency or public interest in the issue. The range of alternatives was developed in response to these key issues, and the potential effects to the issues expected to result from varying levels of surface disturbance and/or inclusion or exclusion of various development guidelines/management protocols. For the DEIS, ranges in the pace of development (75, 150, or 250 wells developed per year) were applied under Alternatives A through G, and a range of well numbers were analyzed (3,100 wells for most alternatives, 1,250 wells for Alternative C, and 2,200 wells for Alternative D). This range in pace of development and well numbers provided a range of effects to socioeconomics and air quality, BLM inspection and enforcement capability, and project duration. The application or renewal of alternative-specific on-site surface disturbance protocols and mitigation (see Section 2.3, and Appendices A and C), including Operator-committed monitoring, reporting and off-site compensatory mitigation (CM), provided a range of potential impacts to key resources/resource issues including air quality, greater sage-grouse, pronghorn antelope, and other wildlife, livestock forage, and BLM inspection and enforcement capability.

2.1.2 Key Issues

Issue 1 The extent of proposed surface disturbance and its effects on all area resources.

Respondents identified the total volume and distribution of proposed surface disturbance associated with the Proposed Action as an issue for numerous area resources (e.g., wildlife and wildlife habitat, cultural resources, vegetation, soils). The extent and duration of surface disturbance was also identified as potentially adversely affecting appropriate management of these area resources.

Issue 2 Pace of proposed development, associated regional socioeconomic effects, and boom/bust avoidance.

Respondents expressed concern with the potential influx of transient workers who do not tend to maintain permanent residence as experienced with past energy development projects; the added burden to area infrastructures such as community support facilities, including hospitals and medical clinics, emergency services, housing, and roads; and inadequate capacity of governments to address infrastructure shortfalls.

Employees also identified as a concern the desire to maintain permanent residence in the area, but held the belief that if BLM does not approve continued development in the JIDPA, they would be forced to relocate. Furthermore, project proponents and local government agencies identified that the potential revenues from tax dollars, royalties, and jobs associated with the proposed project would benefit the State, county, and local communities.

Issue 3 Potential project and cumulative impacts on regional visibility, particularly at area residences and in Class I wilderness areas, and other air quality impacts, including those associated with emission rates, atmospheric deposition, and regulatory authority.

Many respondents indicated that regional haze and smoke plumes have increased locally in association with ongoing natural gas development projects in the region, and that maintenance and improvement of visibility is a requirement of the Clean Air Act within nearby Class I wilderness areas. Other respondents had concerns about project emission effects on worker and area resident health; others were concerned about excessive acid deposition. Nighttime star gazing was also identified as having been locally affected. Additionally, agencies and the public expressed concerns regarding the authority for air quality mitigation requirements.

Issue 4 Project effects to greater sage-grouse, greater sage-grouse habitats, and habitat function.

Respondents identified effects to this species and its habitats as an issue because of the historic population levels of greater sage-grouse in the JIDPA and the apparent decline in greater sage-grouse populations across their range. Potential project effects to breeding, nesting, brood-rearing, and wintering habitat and habitat function were identified as potentially contributing to continued population declines. It was also noted that existing greater sage-grouse protection measures appear to be inadequate within the JIDPA and that with the proposed increase in development, existing protection measures would be even less effective.

Issue 5 Project effects on pronghorn antelope migration corridors leading to and from crucial winter ranges north of the JIDPA.

Current developments in the region were identified as already having adversely affected the historic migrations of the Sublette pronghorn herd. Continued development within the JIDPA and at other locations within the Sublette herd unit area were identified as potentially cumulatively affecting pronghorn seasonal migrations. Hunters, wildlife enthusiasts, and wildlife management agencies all consider the maintenance of existing migratory corridors extremely important to pronghorn population maintenance.

Issue 6 Proposed surface disturbance, human presence, and noise effects to overall habitat loss (direct and indirect) for numerous wildlife species and associated fragmentation of wildlife habitats.

Respondents indicated that, with implementation of the proposed project, the JIDPA would no longer be suitable habitat for many wildlife species (e.g., threatened and endangered species, BLM-sensitive species, and raptors). Habitat loss was attributed to direct loss through surface disturbance, indirect loss through animal avoidance of areas proximal to developments, and habitat fragmentation (habitat is no longer suitable for species requiring intact habitat patches larger than what would be available if the project were constructed).

Issue 7 Maximize natural gas recovery from the field.

Respondents indicated that one of BLM's mandates under the Mineral Leasing Act is to maximize recovery of available resources. It was pointed out that many of the existing and proposed development restrictions (e.g., lease stipulations, RMP requirements, Operator-committed practices) limit the economic feasibility of maximizing recovery of the JIDPA's natural gas resources.

Issue 8 Loss of livestock forage and project-associated hazardous conditions to area livestock/livestock operations.

Respondents indicated concerns for livestock operations on the JIDPA. Concerns were generally associated with the direct loss of livestock forage and the associated potential for a reduction in permitted livestock numbers; livestock water quality impairment at existing water sources; livestock movement restrictions/alterations due to pipeline trenches, roads, and fences; livestock management problems associated with the inability to access required area two-track routes from project-developed crowned-and-ditched roads; and livestock hazards from vehicle collisions, drinking contaminated waters from project pits, entrapment in pipeline trenches, and the increase in fugitive dust emissions potentially causing dust-induced pneumonia.

Issue 9 BLM monitoring and enforcement capability.

Respondents indicated that processing permits for current and proposed levels of natural gas development is limiting BLM staff from adequately fulfilling their concurrent responsibilities for area management (e.g., site inspections, reclamation monitoring, wildlife monitoring, cultural resource clearance actions). It was suggested that this may lead to unidentified violations of numerous laws, rules, and regulations (e.g., Endangered Species Act, Clean Water Act, lease stipulations, RMP requirements, Operator-committed practices required under past project authorizations).

For more detail on these key issues and the variability in scoping respondent concerns see Appendix D.

2.2 DEVELOPMENT OF ALTERNATIVES

2.2.1 Summary of Alternatives Analyzed in the DEIS

The No Action Alternative, the Proposed Action, and eight additional alternatives that the BLM determined were capable of meeting the purpose and need for the project, and that were in compliance with CEQ NEPA requirements under 40 CFR 1502.14 for reasonableness and feasibility based on technical, economic, environmental, and other factors, were analyzed in detail in the February 2005 DEIS. This range of alternatives was also considered highly responsive to the key issues and concerns identified from public scoping (Section 2.1). The alternatives analyzed in the DEIS are summarized below.

The reader should note that throughout these descriptions and the remainder of the EIS, the terms "new surface disturbance" or "new disturbance" are used to denote the total surface disturbance that would be approved in the ROD for this project (i.e., any disturbance beyond the 4,209 acres already authorized by previous NEPA documents). The phrase "short-term disturbance" is used to indicate surface disturbance associated with the well drilling and completion phases of the project (i.e., that portion of new development disturbance from well pads, gathering pipelines, roads, and other necessary project-related infrastructure that is not subsequently reclaimed prior to the project production phase). The term "life-of-project (LOP) disturbance" denotes surface disturbance that will remain after interim reclamation (e.g., regrading and revegetation of portions of developed well pads and entire pipeline ROWs) has concluded, but prior to complete cessation of the production phase and full reclamation and abandonment of the JIDPA.

No Action Alternative: Reject Operators' Proposal

The No Action Alternative would reject the Proposed Action and all new field-level development alternatives. Though this alternative rejects the field-level development as proposed, existing BLM management decisions could allow new drilling activity (BLM 1997a, 1998a, 1998b, 2000a, 2000b). However, the BLM cannot predict what level of development would be required to support existing management protocols, so for alternative analysis purposes assumes no new development. The No Action alternative serves as a benchmark enabling decision-makers and the public to compare the magnitude of environmental consequences across action alternatives. This alternative is carried forward for analysis in this FEIS.

Proposed Action

The Operators propose to increase recovery of natural gas and condensate reserves from the Lance and other formations at depths of approximately 11,000 feet by drilling as many as 3,100 additional wells on up to 16,200 acres of new surface disturbance. Specific features of the proposal include: a minimum of 64 well pads per 640-acre section; downhole well spacing from 1 well/5 acres to 1 well/40 acres; up to 465 miles of new resource roads with associated pipelines; 8 miles of new collector/local roads; 41 acres of new surface disturbance for ancillary facilities;

and 100 acres of new surface disturbance for exploration of other formations. A single well development rate of 250 wells drilled per year (20 simultaneously operating rigs) is assumed. The Operators have committed to various mitigation measures—these vary by alternative—and propose to fund a Cumulative Impacts Mitigation Fund (CIMF) for offsite compensatory mitigation (CM) under some alternatives. The CIMF could mitigate adverse impacts within the JIDPA by financing substitution mitigation projects outside the JIDPA. As proposed, the amount of the fund may be based on the level of authorized surface disturbance. This alternative is carried forward for analysis in this FEIS.

Alternative A: Maximize Mineral Resource Recovery

New short-term (drilling phase) surface disturbance would be comparable to the Proposed Action (16,200 acres), but development activity would be exempt from some existing BLM Conditions of Approval (COAs), stipulations, and mitigation. Most notably, environmentally sensitive areas such as the Sand Draw and greater sage-grouse lek Controlled Surface Use areas would not be avoided in order to increase gas recovery. Three well development rates (75, 150, and 250 wells drilled per year) were analyzed in the DEIS. This alternative, under a single well development rate of 250 wells drilled per year, is carried forward for analysis in this FEIS.

Alternative B: Minimize Surface Disturbance

All new wells would be drilled from the 497 currently approved well pads. This alternative requires expansion of existing well pads but results in the least amount of new surface disturbance (3,222 acres) while still providing for a high level of resource recovery within the JIDPA. Three well development rates (75, 150, and 250 wells drilled per year) were analyzed in the DEIS. This alternative, under a single well development rate of 75 wells drilled per year, is carried forward for analysis in this FEIS.

Alternatives C and D: Restrict Number of New Wells

Alternative C limits development to 1,250 new wells and well pads with an estimated total new surface disturbance of 6,705 acres. Alternative D increases the number of new wells and well pads to 2,200, resulting in new surface disturbance of 11,581 acres. Neither alternative includes well pad surface density restrictions. Three well development rates (75, 150, and 250 wells drilled per year) for each alternative were analyzed in the DEIS. These alternatives are not carried forward for analysis in this FEIS (see Section 2.2.3).

Alternatives E, F, and G: Restrict Well Pad Density

Alternative E stipulates a maximum of 16 well pads per section (1 well pad/40 acres) with a total new surface disturbance of approximately 6,386 acres. Alternative F increases well pad density to 32 wells per section (1 well pad/20 acres) and results in new surface disturbance of 10,446 acres. Alternative G increases the density to 64 wells per section (1 well pad/10 acres) with 13,989 acres of new surface disturbance. Each alternative assumes up to 3,100 new wells would be drilled. Three well development rates (75, 150, and 250 wells drilled per year) for each alternative were analyzed in the DEIS. These alternatives are not carried forward for analysis in this FEIS (see Section 2.2.3).

BLM Preferred Alternative

As presented in the DEIS, under the Preferred Alternative three different surface disturbance allowances per section would be established within different areas of the JIDPA, resulting in a total of approximately 8,316 acres of new surface disturbance. A single well development rate of 250 wells drilled per year is assumed. Performance-based field management objectives would address key issues and significant impacts. Monitoring and surveying would be required to determine if objectives are being met. An interagency adaptive management working group would be established to monitor the effectiveness of development guidelines, mitigation, and monitoring, and to recommend to BLM any modifications to these procedures based on monitoring results. This alternative has been significantly revised for the FEIS (see Section 2.4.5) as a result of public and agency comments on the DEIS.

2.2.2 Publication of the DEIS, Public Meetings, and Public Comments

On February 11, 2005, a Notice of Availability (NOA) of the DEIS for public review and comment was published in the *Federal Register* (70 FR 7296–7298). The DEIS was distributed in both paper and electronic formats (on CD-ROM), and was available for downloading from the BLM's website. Additional copies of these volumes were made available for public inspection at the PFO and at the BLM Wyoming State Office. The BLM invited public and agency comment on the DEIS and the draft air quality and socioeconomic analysis technical support documents (TSDs) for a period of 60 calendar days, until April 12, 2005. BLM-sponsored public meetings to provide an opportunity to discuss the DEIS and the supporting documents were held on March 21, 2005, at BLM's Rock Springs office and March 23, 2005, at Rendezvous Pointe in Pinedale.

Subsequent to publication of the DEIS, BLM determined that the air quality modeling and analysis done for the DEIS provided insufficient information for meaningful impact evaluation, largely because new analysis in another document showed emission levels of certain pollutants within the regional airshed had increased significantly since the original DEIS data had been compiled. Following consultation with the EPA and Wyoming Department of Environmental Quality-Air Quality Division (WDEQ/AQD), the BLM determined that supplemental air quality modeling and analysis would be conducted, DEIS and TSD supplements would be published, and the results of these studies would be incorporated into the FEIS. Therefore, on April 12, 2005, BLM published an Notice of Intent (NOI) in the *Federal Register* (70 FR 19094) to inform the public that supplemental DEIS documents would be prepared and that additional time would be made available to submit comments on the air quality information presented in the DEIS. When the new supplemental air quality information became available for public review and comment in August 2005, BLM published a new NOA in the *Federal Register* (70 FR 46187) and provided the public with an additional 60-day comment period.

BLM received a total of 877 separate written comment submissions (letters, e-mails, forms, etc.) on the DEIS, TSDs, and the August 2005 supplements. Within these submissions, 1,147 individual comments were identified as "substantive," or meaningful to revision of the DEIS and/or its supporting volumes. Some submissions had several substantive comments; some had none. BLM crafted responses to each of these substantive comments, which were used to guide revision of the DEIS analyses. The substantive comments received and the responses that were generated as a result became central to the IDT's decision to significantly revise the Preferred Alternative and to eliminate five of the alternatives presented in the DEIS from further consideration in the FEIS. All substantive comments, along with BLM's responses, are included in Volume 3, *Jonah Infill Drilling Project Comment Analysis Report*.

Subsequent to publication of the DEIS, BLM also determined that additional erosion modeling was needed to assess the relative impacts of the alternatives on soil loss and sedimentation of surface waters. The results of this modeling have been incorporated into the impact analysis in Chapter 4 of this document. The full modeling report, *Erosion, Sediment Transport, and Salinity Modeling Technical Report: Jonah Infill Drilling Project, Sublette County, Wyoming* (HydroGeo 2005) is included as Appendix E.

2.2.3 Alternatives Considered and Eliminated from Detailed Study

2.2.3.1 DEIS Alternatives Not Carried Forward for Final Analysis

Of the 10 alternatives that were analyzed in detail in the DEIS, the IDT determined that five of these alternatives—Alternatives C, D, E, F, and G—would not be carried forward for final analysis in the FEIS. The BLM also determined that multiple well development rates within any single alternative would not be further analyzed.

Alternatives C and D provided different limits to restrict well numbers and were initially considered in the DEIS to provide a range of impacts to air quality. Alternative C proposed limiting development to 1,250 new wells and well pads and an estimated surface disturbance of 6,705 acres. Alternative D would have limited the number of new wells and well pads to 2,200 and an estimated surface disturbance of 11,581 acres. Neither Alternative C nor Alternative D limited well or well pad surface density. These two alternatives were eliminated from additional analysis because neither alternative is considered reasonable: at least 3,100 additional wells would be required to fully develop the field and anything less would result in stranded resources that would most likely never be recovered. Allowing mineral resources to remain unrecovered, as would occur under these and similar alternatives, would result in waste and prevent BLM from achieving its statutory and policy goals. In addition to not fully recovering the resource, Alternatives C and D would result in impacts similar to those resulting from components of the alternatives that are carried forward in this FEIS. Specifically, these components are individual wells from closely spaced well pads under Alternative A, multiple wells from a single well pad as analyzed in Alternative B, and a combination of single and multiple well pads as analyzed under the Preferred Alternative.

Alternatives E, F, and G provided variable surface well pad spacing allowances, and were initially considered to provide a range in the amount and distribution of surface disturbance across the JIDPA. Alternative E examined drilling and developing 16 wells from 16 well pads in a section, resulting in approximately 6,386 acres of additional disturbance. Alternative F analyzed the effects of increasing the well pad density to 32 well pads per section for a total of 10,446 acres of additional disturbance. Finally, Alternative G examined the effects of 64 well pads per section (one well pad for every 10 acres) at an estimated total additional disturbance of 13,898 acres. As with Alternatives C and D, these alternatives were eliminated from further consideration in the FEIS because the anticipated impacts from the alternative actions would be similar to those resulting from components of the alternatives that are carried forward for additional analysis in this FEIS.

Alternate paces of development within each alternative were eliminated from further analyses in this FEIS because it was determined that providing this information within each alternative introduced a level of complexity which made it difficult for the public and decision-makers to assess potential impacts across the full range of alternatives. Two development rates (250 and 75 wells drilled per year) are carried forward as parts of specific alternatives analyzed in this

FEIS, and with these analyses a sufficient range of resource effects (e.g., LOP, air quality, socioeconomics) is provided.

2.2.3.2 Other Alternatives Considered and Eliminated from Detailed Study

Many suggestions for alternatives were proposed by the public during scoping. Most of the suggested alternatives involved addressing varying well numbers, varying the rate at which the field is developed, and varying surface disturbance. While not all the suggested well number, development rate, or surface disturbance suggestions were analyzed, the BLM used these suggestions when developing the range of alternatives.

An alternative rejecting any new development was also suggested. While additional development in the area would likely occur under any no development alternative (e.g., State of Wyoming land development), for analytic purposes, the No Action Alternative sufficiently considers no new development-type impacts (see Section 2.4.1).

Action alternatives limiting the total number of wells were rejected from consideration based upon known natural gas reservoir properties indicating that an estimated 3,100 additional wells would be necessary for adequate resource recovery. Additional justification for eliminating these alternatives from detailed analyses is provided in Section 2.2.3.1.

Phased development alternatives suggesting a development pace slower than 75 wells per year were rejected from detailed analyses because the reduced development pace would result in recovery and operational and safety issues associated with drilling through depressurized zones (i.e., stuck pipe, mud weight variability problems, blow-out potential). It was determined that the analyzed development paces of 75 and 250 wells drilled per year provide an adequate range of development paces to assess the potential effects associated with development rate (e.g., socioeconomics, duration of habitat loss). Phased development alternatives involving systematic extraction of resources from portions of the JIDPA followed by appropriate reclamation prior to developing other areas of the JIDPA were not provided detailed analyses due to the potential for disproportionate adverse effects on resource recovery within some leaseholds (see also Section 2.2.3.1). Allowing mineral resources to remain unrecovered would result in waste and prevent BLM from achieving its statutory and policy goals.

Two alternatives requiring all new wells to be directionally drilled and requiring no new roads were not specifically analyzed in detail because Alternative B has a similar potential effect (i.e., no new well pads, few new roads needed).

An alternative rejecting all further development in the JIDPA until all existing disturbance in the area is adequately reclaimed was not considered since this action would likely lead to considerable unrecovered resource and would unnecessarily prolong the LOP.

Numerous alternatives requiring the inclusion/exclusion of multiple resource protection, mitigation, and monitoring measures were suggested for analysis, including the application of best management practices (BMPs), the use of adaptive management procedures, and consideration of off-site CM (see Chapter 5). Some of these additional measures have been included as components of the Proposed Action and Preferred Action alternatives and/or may be included as project requirements in the ROD. Many if not all of these suggested requirements are considered under one or more of the alternatives analyzed in detail (see also Appendices A and C for BLM standard mitigations, Operator-committed measures, and CM ideas).

2.3 ALTERNATIVES CARRIED FORWARD FOR FINAL ANALYSIS

2.3.1 Features Common to All Alternatives Carried Forward for Final Analysis

2.3.1.1 General Features

All applicable federal, state, and local laws, rules, and regulations would be applied under any approved alternative, and all requirements listed in Appendix A, *BLM Standard Stipulation/Mitigation Requirements*, would be implemented under all alternatives except Alternative A. To minimize directional drilling for the purpose of maximizing gas recovery under Alternative A, requirements for avoiding selected resources such as steep slopes, Sand Draw, greater sage-grouse leks, and raptor nests were not applied.

Development requirements and procedures common to all alternatives are provided in Appendix B, *Development Procedures Technical Support Document* (BLM 2004a) and in general these procedures would be applied under all alternatives.

Appendix C provides a list of Operator-committed measures; these will be finalized in the ROD for this project.

Absent specific revisions in the ROD for this project, Operators would comply with the management objectives, COAs, standard stipulations, and mitigation measures identified in the BLM PFO RMP ROD (BLM 1988b), and BLM RSFO RMP ROD (BLM 1997b). Under any alternative, Operators must comply with all appropriate federal, state, and local laws and regulations, and all appropriate permits from the appropriate regulatory agency must be obtained before proceeding.

General features of management applicable to all alternatives carried forward for analysis in this FEIS are listed below.

Water

- Operators would maintain or restore groundwater and surface water quality in the Jonah Field to Clean Water Act and WDEQ standards.

- A groundwater monitoring program for all water wells in or affected by activities in the JIDPA would be implemented, with annual reports to BLM, Wyoming State Engineer's Office (WSEO), and WDEQ. Water wells would be tested annually for drawdown, general chemical constituents, and total petroleum hydrocarbons, using WDEQ-approved methods.

Transportation

- Operators would continue to encourage limiting the speed of all vehicles operated by the leaseholder, Operator, or Operator agents in the JIDPA, and would implement voluntary fugitive dust control measures on primary access roads and heavily used resource roads

- Project-required traffic in the JIDPA would be limited to BLM-approved roads. Operators would continue to cooperate with the BLM to identify and prohibit use of two-tracks where ROWs have not been obtained.
- Operators would utilize remote telemetry or equivalent technology at all wells to minimize well monitoring trips, unless proven to the satisfaction of the authorized officer on a case-by-case basis that installation of remote telemetry or equivalent technology would not be technically or economically feasible, or that another method would create less environmental impact.

Reclamation

- Operators would submit to BLM for approval a reclamation plan, to include both interim and long-term reclamation of the JIDPA, within 1 year of the ROD for this project (see Appendix B). A reclamation quality assurance/quality control monitoring program would be implemented until development and interim (production phase) reclamation is completed to BLM standards.

- Operators would employ appropriate topsoil storage and replacement technology and procedures to ensure soil viability and plant rooting potential are maintained.

Wildlife

- Operators would monitor nesting of raptors, including ferruginous hawk, bald eagle, and burrowing owl; greater sage-grouse lek attendance; and occurrence of other sagebrush-obligate species within the JIDPA in coordination with BLM and WGFD.

2.3.1.2 Conditions of Approval

The COAs applicable to all alternatives carried forward for final analysis in this FEIS are listed below.

- Operators would monitor water withdrawal volumes from water wells and provide annual depletion reports to the BLM, WSEO, and USFWS.

- New well pads would be designed and constructed to meet WDEQ stormwater discharge requirements.

- Hydraulic structures (culverts, bridges, low water crossings, silt traps, catchments, retention dams, etc.) placed in existing, natural drainage courses would be engineered and designed by a certified civil engineer to ensure the structures are stable and erosion is minimized. Cross-drain structures installed outside existing, natural drainage courses would not require certified civil engineer design.

- All well pads, roads, pipelines, and other facilities would be engineered and constructed to minimize sedimentation down-channel from the JIDPA.

- All water wells would be cemented or grouted as required by the WSEO to protect groundwater aquifers.

- Operators would restore those portions of pads not needed for production operations to as close to original contours as practical during interim reclamation to minimize or eliminate the need to re-disturb those reclaimed areas when wells are plugged and abandoned.

2.3.2 Features Common to the Proposed Action, Alternative B, and the Preferred Alternative

Because Alternative A was specifically designed to maximize mineral resource recovery within the JIDPA by exempting the Operators from certain standard management practices, the following conditions would only be applicable to the Proposed Action, Alternative B, and the Preferred Alternative:

- The Sand Draw Conditional Surface Use restriction (formerly referred to as a No Surface Occupancy restriction) would be maintained.

- Well pads, access roads, and other aboveground facilities would not be located within 825 feet of an active raptor nest, within 1,000 feet of an active ferruginous hawk nest, or within 2,640 feet of any bald eagle nest.

- The following seasonal restrictions for activities near active raptor nests/roosting sites/foraging areas would be imposed:

  - February 1 through July 31, within 0.5 mile of all active raptor nests;
  - February 1 through July 31, within 1.0 mile of all active ferruginous hawk nests;
  - February 1 through August 15, within 1.0 mile of all active bald eagle nests;
  - November 1 through April 1, within 1.0 mile of active bald eagle communal winter roosts; and
  - November 1 through April 1, within 2.5 miles of a bald eagle nest and within 1.0 mile of winter forage areas.

- Operators would monitor nesting of raptors, including ferruginous hawk, bald eagle, and burrowing owl; greater sage-grouse lek attendance; and occurrence of other sagebrush-obligate species in coordination with BLM and WGFD.

- Surface-disturbing and disruptive activities in greater sage-grouse winter habitat would be avoided from November 15 through March 14.

- Surface-disturbing and disruptive activities in greater sage-grouse nesting and early brood-rearing habitat within 2.0 miles of an occupied lek, or in identified greater sage-grouse nesting and early brood-rearing habitat outside the 2.0-mile buffer would be prohibited from March 15 through July 15.

- Surface disturbance and occupancy would be prohibited within 0.25 mile of the perimeter of greater sage-grouse leks, and human activity in these areas would be avoided between 8 p.m. and 8 a.m. from March 1 through May 15.

2.4 ALTERNATIVES ANALYZED IN DETAIL

The No Action, the Proposed Action, and three alternative development actions (Alternative A, Alternative B, and the BLM Preferred Alternative) are evaluated in this FEIS. A brief comparison of alternatives is provided in Table 2.1.

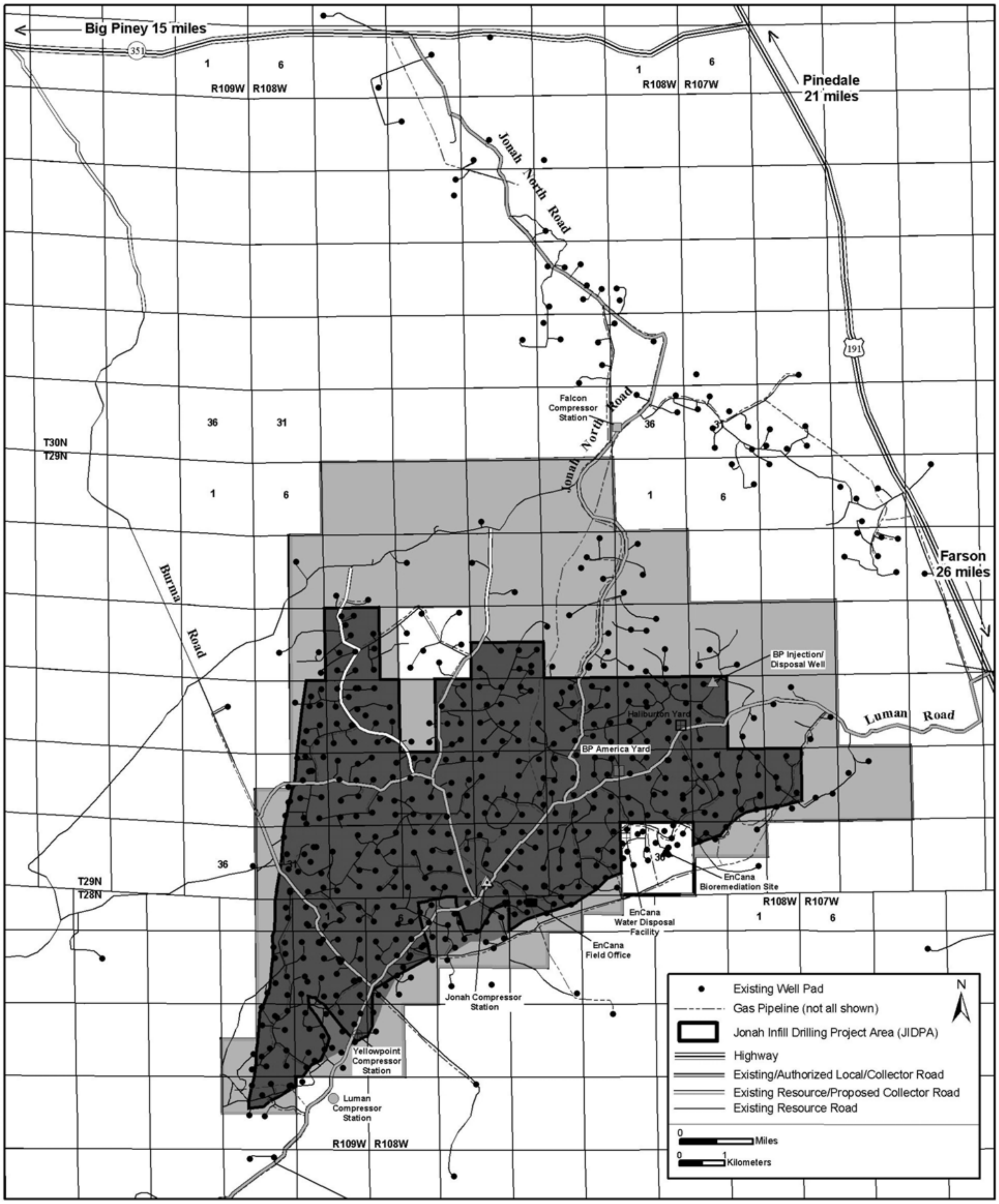
Table 2.1. Comparison of Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Project Parameter	Alternative				
	No Action[1]	Proposed Action[2]	A[2]	B[3]	BLM Preferred Alternative[4]
Development Features					
Total Acres Surface Disturbance[5]	4,209	20,409	20,409	7,431	14,030–20,334
Total Acres New Disturbance	0	16,200	16,200	3,222	9,821–16,125
LOP Acres Surface Disturbance	1,409	6,040	6,040	2,600	4,267–6,020
Total Miles of Resource Roads/Gathering Pipelines	199	664	664	199	488–710
Total Miles of Collector/Local Roads	38	46	46	46	46
Total Number of Natural Gas Well Pads	497	3,597	3,597	497	3,597
These development features directly or indirectly affect habitat loss and fragmentation for all species, pronghorn migration, visibility, livestock hazards and available forage, socioeconomics, and gas recovery.					
Pace of Development					
Wells Developed per year	0	250	250	75	250
Development Phase (years)	0	13	13	42	13
Production Phase (years)	40	40	40	40	40
	23	23	23	23	23
Total Life-of-Project (years)	63	76	76	105	76
Pace of development directly or indirectly affects duration of habitat and forage loss, visibility, socioeconomics, gas recovery, and BLM enforcement and monitoring capability.					

[1] See Table 2.2 for further detail.
[2] See Table 2.3 for further detail.
[3] See Table 2.4 for further detail.
[4] See Table 2.5 for further detail. New disturbance in excess of 9,821 acres is contingent on successful on-site reclamation to BLM standards.
[5] Total disturbance includes 4,209 acres already allocated for disturbance through the existing Jonah NEPA documents (BLM 2000b) plus new disturbance proposed under each alternative.

2.4.1 No Action Alternative – Reject Operators' Proposal

Under the No Action Alternative, the BLM would reject the Operators' proposal for additional field-level natural gas development on federal lands within the JIDPA. Authorizations for and impacts from previously approved or analyzed development (533 wells) and surface disturbance (497 well pads with associated roads, pipelines, and ancillary facilities) would continue (BLM 1998b, 2000b). The approved surface disturbance under the No Action Alternative is 4,209 acres, including 1,409 acres of LOP disturbance (Table 2.2). LOP is estimated to be approximately 63 years (see Table 2.1). The types and locations of existing surface disturbance in the JIDPA are presented in Map 2.1.



Map 2.1. Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006.

However, rejection of the Operators' proposal would not preclude all additional natural gas development in the JIDPA. The No Action Alternative assumes the JIDPA would be managed as approved by existing management plans (BLM 1988b, 1997b) and as previously authorized by APDs and ROWs issued under existing decisions (BLM 1998b, 2000b). Though the extent of potential future development under this scenario is limited, it cannot be precisely predicted. Therefore, the impact analysis for the No Action Alternative assumes no new development.

Table 2.2. Surface Disturbance Allowed by the No Action Alternative, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Project Parameter [2]	Disturbance (acres)		
	Total	Short-term	LOP
Well Pads [3]	1,889	1,442	447
Resource Roads/Gathering Pipelines [4]	1,766	1,067	699
Collector/Local Roads [5]	239	120	119
Burma Road [6]	35	0	35
Ancillary Facilities [7]	87	7	80
Water Wells [8]	0	0	11
Sales Pipeline [9]	133	133	0
Exploration Activities [10]	60	42	18
Total [11]	4,209	2,811	1,409

1 Generally as described in the EA for the Modified Jonah Field II Natural Gas Project (BLM 2000a).
2 Includes all project parameters identified in BLM (2000a) as well as those proposed for the current project.
3 Assumes approximately 533 wells from 497 pads at 3.8 acres total and 0.9 acre LOP disturbance per pad.
4 Assumes a 0.4-mile road with adjacent gathering pipeline for each well pad with average total and LOP disturbance widths of 73.3 feet and 29.0 feet, respectively (approximately 199 linear miles of road at 8.9 acres/mile total disturbance and 3.5 acres/mile LOP).
5 Assumes 26 miles of collector roads with average total and LOP disturbance widths of 75.7 feet and 37.8 feet, respectively (approximately 9.2 acres/mile total disturbance and 4.6 acres/mile LOP disturbance).
6 Includes the approximately 12-mile road length outside the JIDPA and assumes an existing width of 24 feet.
7 Includes disturbances from four compressor stations, water disposal facilities, field offices, ware yards, a sand pit, and other facilities required for the existing project and occurring both within and outside the JIDPA. Approximately 7 acres of this disturbance would be reclaimed after completion of currently approved or committed to drilling activities.
8 Includes disturbance from approximately 25 existing water wells that have been developed on existing natural gas well pads; water wells require no new disturbance and less than 0.5 acre of disturbance each for the LOP.
9 Includes an approximately 22-mile pipeline corridor with 50-foot disturbance width for sales pipelines outside the JIDPA.
10 All exploration activities are included in the disturbance area estimates listed above. Disturbance estimates include areas occupied by existing natural gas developments (pads [five], roads, pipelines) in the N$^1/_2$ Section 23, T28N, R109W.
11 Includes 4,001 acres total and 1,348 acres LOP disturbance within the JIDPA, respectively; the additional 208 acres total and 61 acres LOP disturbance occur at locations outside the JIDPA (e.g., Burma Road, compressor stations).

2.4.2 Proposed Action

If selected, the Operators would infill drill and develop up to 3,100 new wells on a minimum of 64 well pads/section (at least 1 pad every 10 acres) with related roads, pipelines, and ancillary facilities on up to 16,200 acres of new disturbance.

Drilling would begin in 2006 and continue until the total number of proposed wells have been drilled, the natural gas resources in the field have been fully developed, or economic conditions are such that it is no longer profitable to drill additional wells.

Operator reservoir modeling shows that 3,100 new wells would be necessary to adequately recover the natural gas resource present in the area. Their experience indicates that the use of directional drilling is in some cases not economically feasible and in other cases results in inadequate resource recovery.

The Proposed Action assumes that 250 wells would be developed annually (20 rigs operating year-round). LOP would be approximately 76 years (see Table 2.1).

If selected, the Proposed Action would approve:

- up to 3,100 new wells on up to 11,780 acres new disturbance (2,790 acres LOP)—assumes all 3,100 wells would be drilled from single-well pads with an estimated total disturbance of 3.8 acres and 0.9 acre LOP per single well pad;

- 465 miles of new resource roads with gathering pipelines—4,131 acres new disturbance (1,635 acres LOP);

- 8 miles of new collector/local roads—73 acres new disturbance (37 acres LOP);

- an upgrade of approximately 12 miles of the Burma Road—75 acres new disturbance (20 acres LOP);

- ancillary facilities—41 acres new disturbance (all LOP) for water disposal, storage, and compressor station facilities; and

- exploration activities—100 acres new disturbance (all LOP) to develop well pads and other infrastructures necessary to explore for natural gas resources in formations other than the Lance Pool (Table 2.3).

Following successful interim reclamation (post-drilling during production phase), LOP surface disturbance under the Proposed Action would be 6,040 acres, which includes 1,409 acres of existing disturbance (see Table 2.3).

Operators have identified a number of mitigation/development practices they would apply during development of the Proposed Action (see Appendix C).

2.4.3 Alternative A – Maximize Mineral Resource Recovery

Alternative A is similar to the Proposed Action in its estimated surface disturbance requirements (see Section 2.4.2 and Table 2.3), but differs from the Proposed Action in that known areas with sensitive resources in the JIDPA would not be avoided (e.g., Sand Draw, steep slopes, raptor nest and sage grouse lek buffers). Development of natural gas resources beneath these areas would therefore not require the use of directional drilling. A rate of development of 250 wells per year and an LOP of 76 years are assumed under Alternative A. This alternative would not necessarily provide for the RMP-required balance between gas recovery and other resource protection; therefore, project authorization under this alternative would require an RMP amendment. Other features of Alternative A include:

- Well pads, access roads, and other aboveground facilities could be located within 825 feet of active raptor nests.

- Surface disturbance and occupancy would not be prohibited within 0.25 mile of the perimeter of greater sage-grouse leks.

- Prairie dog towns would not be avoided.

- The Sand Draw Conditional Surface Use restriction (formerly referred to as a No Surface Occupancy restriction) and other drainage and steep slope avoidance areas would not be maintained.

Operators have identified a number of mitigation/development practices they would apply during development of Alternative A (see Appendix C).

Table 2.3. Surface Disturbance Allowed by the Proposed Action and Alternative A, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Project Parameter	Disturbance (acres)		
	New	Short-term	LOP
Well Pads [1]	11,780	8,990	2,790
Resource Roads/Gathering Pipelines [2]	4,131	2,496	1,635
Collector/Local Roads [3]	73	36	37
Burma Road [4]	75	55	20
Ancillary Facilities [5]	41	0	41
Water Wells [6]	0	0	8
Sales Pipeline [7]	0	0	0
Exploration Activities [8]	100	0	100
Total New Disturbance	16,200	11,577	4,631
Existing Disturbance [9]	4,209	2,811	1,409
Total New and Existing Disturbance [10]	20,409	14,388	6,040

1 Conservatively assumes all well pads are single-well pads and require 3.8 acres new total and 0.9 acre new LOP disturbance per pad.
2 Assumes an average well pad access road/gathering pipeline length of 0.15 mile for each pad with average new total and new LOP disturbance widths of 73.3 feet and 29.0 feet, respectively (approximately 465 linear miles of road).
3 Assumes approximately 8 miles of new collector/local roads would be required (existing resource roads may be expanded in some areas to serve as collector/local roads), and roads would have average new total and new LOP disturbance widths of 75.7 feet and 37.8 feet, respectively.
4 Assumes an approximate 12-mile road length outside the JIDPA with new total and new LOP disturbance widths of 51.7 feet (75.7 feet required less 24.0 feet existing) and 13.8 feet (37.8 feet required less 24.0 feet existing), respectively.
5 Accommodates areas potentially required for new water disposal facilities, storage yards, and increased pipeline compression capacity.
6 Approximately 16 new water wells would be developed on natural gas well pads. Water wells would require no new surface disturbance; assumes 0.5 acre LOP disturbance per water well.
7 No new sales pipelines are proposed.
8 An estimated 100 acres of new disturbance (all LOP) is included to allow for exploration of geologic formations other than the Lance Pool and Mesa Verde.
9 See Table 2.2.
10 Estimates include 20,126 acres new total and 5,959 acres new LOP disturbance in the JIDPA, respectively; the additional 283 acres new total and 81 acres new LOP disturbance would occur outside the JIDPA.

2.4.4 Alternative B – Minimize Surface Disturbance

Surface disturbance would be reduced under Alternative B by requiring all new wells be drilled from existing well pads. Existing well pads would need to be enlarged and new pipelines built within existing pipeline corridors. A rate of development of 75 wells per year and an LOP of 105 years are assumed under Alternative B. If selected, Alternative B would approve:

- expansion of existing well pads—3,081 acres new disturbance (1,044 acres LOP)—6.2 acres new disturbance (3.0 acres LOP) per well pad expansion;

- ancillary facilities—41 acres new disturbance (all LOP) for water disposal, storage, and compressor station facilities; and

- exploration activities—100 acres new disturbance (all LOP) to develop well pads and other infrastructures necessary to explore for natural gas resources in formations other than the Lance Pool (Table 2.4).

Following successful interim reclamation, LOP surface disturbance under Alternative B would total 2,622 acres, which includes 1,409 acres of existing disturbance (see Table 2.4).

Although directional drilling under Alternative B would minimize surface disturbance and thereby benefit wildlife and other resources, it would also increase air emissions by approximately 20% over the Proposed Action and Alternative A. Thus, Alternative B could have a greater impact on air quality resources (see Chapter 4, Section 4.1.2).

Appendix C, Exhibit C-1 lists the Operator-committed practices that would be applied under Alternative B.

Table 2.4. Surface Disturbance Allowed by Alternative B, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Project Parameter	Disturbance (acres)		
	New	Short-term	LOP
Well Pads [1]	3,081	2,037	1,044
Resource Roads/Gathering Pipelines [2]	0	0	0
Collector/Local Roads [3]	0	0	0
Burma Road [4]	0	0	0
Ancillary Facilities [5]	41	0	41
Water Wells [6]	0	0	8
Sales Pipeline [7]	0	0	0
Exploration Activities [8]	100	0	100
Total New Disturbance	3,222	2,037	1,193
Existing Disturbance [9]	4,209	2,811	1,409
Total New and Existing Disturbance [10]	7,431	4,848	2,602

[1] Assumes expansion of existing well pads to accommodate 3,100 new wells (no new pads). Assumes all 497 existing pads would be expanded by an average of 6.2 acres initially (10.0 acres per multi-well pad less 3.8 acres existing disturbance) and 2.1 acres for the LOP (3.0 acres per multi-well pad less 0.9 acre of existing disturbance).

[2] No new resource roads would be constructed, and while new gathering pipelines may be built, they would be constructed in existing pipeline corridor disturbance areas.

[3] No new collector/local roads would be constructed.

[4] Burma Road improvements would not be performed under Alternative B.

[5] Accommodates areas potentially required for new water disposal facilities, storage yards, and increased pipeline compression capacity.

[6] Approximately 16 new water wells would be developed on natural gas well pads. Water wells would require no new surface disturbance; assumes 0.5 acre LOP disturbance per water well.

[7] No new sales pipelines would be constructed.

[8] An estimated 100 acres new disturbance (all LOP) is included to allow for exploration of geologic formations other than the Lance Pool and Mesa Verde.

[9] See Table 2.2.

[10] Includes approximately 7,223 acres new total and 2,541 acres new LOP disturbance in the JIDPA, respectively; the additional 208 acres new total and 61 acres new LOP disturbance would occur outside the JIDPA.

2.4.5 BLM Preferred Alternative

The extensive and detailed public comment and associated technical information received on the DEIS, and subsequent new analyses conducted by BLM and WDEQ directly related to this information, have led BLM to revise its Preferred Alternative. The revised Preferred Alternative, and its associated outcome-based performance objectives, mitigation, and Best Management Practices (BMPs), would achieve high levels of natural gas recovery (potentially that of the Proposed Action) while minimizing impacts related to the key issues (see Section 2.1). BLM has concluded that this management approach would achieve the fewest long-term impacts while allowing recovery of the mineral resource as provided by federal laws and regulations, including FLPMA, and extant leasing stipulations.

If selected, the revised Preferred Alternative would limit total surface disturbance at any given time to 46% of the JIDPA, or a maximum of 14,030 acres. To mitigate surface disturbance and associated environmental impacts as quickly as possible, Operators would be required to initiate reclamation of developed well pads and road and pipeline construction ROWs pursuant to Reclamation Plan specifications (Appendix B, subappendix DP-B). Credit would thereafter be given, on an acre-for-acre basis for areas the BLM determines have successfully been reclaimed (i.e., achieved 80% indigenous vegetative basal cover/density and species composition). Under no circumstances would cumulative total surface disturbance exceed 20,334 acres over the LOP (Table 2.5).

BLM would not specifically regulate the pace of development. For the purposes of analysis, a total of 3,100 new wells and a pace of 250 wells drilled per year are assumed, resulting in the field development phase being completed in approximately 13 years. However, the actual pace of development may be limited by air quality impact restrictions and associated mitigation, which creates the potential to increase the duration of the field development phase. For the purposes of analysis the LOP is assumed to be 76 years.

Additional specific provisions of the Preferred Alternative are as follows:

- An interagency mitigation and monitoring implementation group, tentatively called the Jonah Interagency Mitigation and Reclamation Office (JIO), would be established and begin working once the ROD is issued. Details of JIO composition, objectives, and operating procedures are provided in Appendix F. General provisions of the JIO are as follows:

  - The JIO would oversee implementation of mitigation and monitoring of JIDP activities, including compensatory mitigation.

  - The JIO would include BLM, WDEQ, WGFD, and the Wyoming Department of Agriculture.

  - Funding for the JIO would be provided by the Operators.

  - BLM would consider annual JIO adaptive management recommendations to adjust COAs, monitoring, mitigation, and/or BMPs to meet field development and production objectives throughout the LOP.

- BLM would require implementation of Operator-committed compensatory mitigation at issuance of the ROD as appropriate and consistent with BLM policy (see Chapter 5 and Appendix C for a detailed discussion of compensatory mitigation goals and objectives, performance standards, and program-specific strategies).

- The *Wildlife Monitoring/Protection Plan* (Appendix D, *Record of Decision for the Jonah Field II Natural Gas Development Project Environmental Impact Statement, Sublette County, Wyoming* [BLM 1998b] as most recently adapted) would be modified to address activities within the JIDPA and include a habitat mitigation plan.
- To reduce potential wildlife impacts, no further improvements to the Burma Road would be authorized. That portion of the Burma road that is currently upgraded would be maintained to BLM standards.

Following successful interim reclamation and assuming the application of the maximum reclamation credit (6,379 acres), LOP surface disturbance under the BLM Preferred Alternative would total 6,020 acres, which includes 1,409 acres of existing long-term disturbance (see Table 2.5).

Table 2.5. Surface Disturbance Allowed by the BLM Preferred Alternative, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Project Parameter	Disturbance (acres)		
	New	Short-term	LOP
Well Pads [2]	7,113–11,780	5,428–8,990	1,685–2,790
Resource Roads/Gathering Pipelines [3]	2,494–4,131	1,507–2,496	987–1,635
Collector/Local Roads [4]	73	36	37
Burma Road [5]	0	0	0
Ancillary Facilities [6]	41	0	41
Water Wells [7]	0	0	8
Sales Pipeline [8]	0	0	0
Exploration Activities [9]	100	0	100
Total New Disturbance	9,821–16,125	6,971–11,577	2,858–4,611
Existing Disturbance [10]	4,209	2,811	1,409
Total New and Existing Disturbance	14,030–20,334	9,782–14,388	4,267–6,020

1 Provides the full range of disturbance acreage estimates, with the low-end estimates being limited to 46% of the JIDPA and the high-end estimates assuming the application of the entire 6,379-acre reclamation credit. High-end estimates are consistent with the estimates provided for the Proposed Action.
2 Conservatively assumes all well pads are single-well pads and require 3.8 acres new total and 0.9 acre new LOP disturbance per pad.
3 Assumes an average well pad access road/gathering pipeline length of 0.15 mile for each pad with average new total and new LOP disturbance widths of 73.3 feet and 29.0 feet, respectively (approximately 465 linear miles of road).
4 Assumes approximately 8 miles of new collector/local roads would be required (existing resource roads may be expanded in some areas to serve as collector/local roads), and roads would have average new total and new LOP disturbance widths of 75.7 feet and 37.8 feet, respectively.
5 Burma Road improvements would not be performed under the Preferred Alternative.
6 Accommodates areas potentially required for new water disposal facilities, storage yards, and increased pipeline compression capacity.
7 Approximately 16 new water wells would be developed on natural gas well pads. Water wells would require no new surface disturbance; assumes 0.5 acre LOP disturbance per water well.
8 No new sales pipelines would be constructed.
9 An estimated 100 acres new total and new LOP disturbance is included to allow for exploration of geologic formations other than the Lance Pool and Mesa Verde.
10 See Table 2.2.

2.4.5.1 Outcome-Based Performance Objectives

Project development and production under the BLM Preferred Alternative would apply outcome-based performance objectives to allow Operators to utilize innovations to maximize gas recovery while providing long-term protection for other resources in the JIDPA. Furthermore, the Preferred Alternative encourages Operators to develop and use the most effective technologies and processes available to achieve these objectives. The outcome-based performance objectives for the BLM Preferred Alternative are listed below, categorized by resource.

Land Use/Surface Disturbance

- Continue developing and implementing innovations by utilizing state-of-the-art technologies and JIDPA-wide planning throughout the LOP to minimize well pad, road, pipeline, and ancillary facility surface disturbance.

Air Quality

- Air Quality Goal 1a: Minimize the impact of management actions in the planning area on air quality by complying with all applicable air quality laws, rules, and regulations.
  - Air Quality Objective 1a.1: Maintain concentrations of criteria pollutants associated with management actions in compliance with applicable Wyoming and National Ambient Air Quality Standards (WAAQS, NAAQS).
  - Air Quality Objective 1a.2: Maintain concentrations of Prevention of Significant Deterioration (PSD) pollutants associated with management actions in compliance with the applicable increment.
- Air Quality Goal 1b: Implement management actions in the planning area to improve air quality as practicable.
  - Air Quality Objective 1b.1: Reduce visibility-impairing pollutants, in accordance with the reasonable progress goals and time-frames established within the State of Wyoming's Regional Haze State Implementation Plan (SIP).
  - Air Quality Objective 1b.2: Reduce atmospheric deposition pollutants to levels below federally established levels of concern (LOC) and levels of acceptable change (LAC).

Water Resources/Soils

- Maintain sediment erosion (salt and silt discharge rates) from the JIDPA at background levels.

Noise

- Design, construct, and implement operations so that ambient noise levels do not exceed 75 A-weighted decibels (dBA) 30 feet from the noise source (e.g., border of drill pad, compressor, etc.), where technically and economically feasible.

Biological Resources

- Meet BLM Wyoming Standards for Healthy Rangelands (Appendix A, Section A.2).

- Plan field-wide development activities and interim and final reclamation to maximize undisturbed/reclaimed habitat patch size and reduce habitat fragmentation for sagebrush-obligate species.

- Maintain the integrity of big game migration routes and movement corridors.

- Reclaim sites to establish indigenous vegetative cover, structure, and species composition; maintain soil stability; provide forage nutritional value and palatability; and prevent invasive plant and noxious weed establishment.

Visual Resources

- Reduce visual intrusions through the use of new technology, removal of unnecessary equipment, and use of the most appropriate equipment and paint colors as these become available throughout the LOP.

2.4.5.2 Required Operating Procedures and Best Management Practices

The Operators would implement the following required operating procedures and BMPs for all project actions within the JIDPA. Broad-spectrum procedures or BMPs, such as mapping all prairie dog colonies within the JIDPA, inventorying roads and trails, maximizing centralized production facilities, inventorying greater sage-grouse seasonal habitats, etc., would be programmatically implemented. Others would be implemented on a case-by case basis through the Surface Use Plan of an APD or the Plan of Development for a ROW application. Based on environmental assessments (EAs) for individual APDs or ROW applications, BLM may apply site-specific COAs to the APD or ROW grant. BLM would consider annual JIO recommendations to adjust these requirements to meet field development and production objectives throughout the LOP.

Exceptions to the following procedures and BMPs may be granted if a thorough analysis by BLM determines that the resource(s) for which the measure was developed would not be unacceptably impacted by the approved project. Exceptions may also be granted if the Operator can demonstrate to the satisfaction of the authorized officer on a case-by-case basis that the required mitigation or practice would not be technically or economically feasible, or that another method would create less environmental impact.

Land Use/Surface Disturbance

- Operators would track surface disturbance acreage. Operators would provide BLM and the JIO with Federal Geographic Data Committee (FGDC)-compliant metadata and geographic information system (GIS)/global positioning system (GPS) location data for all newly developed facilities and reclaimed areas within 30 days of completion of disturbance and/or reclamation activities.

- Operators would track well numbers in the JIDPA and provide BLM and the JIO with data within 30 days of drilling or abandoning wells.

- Operators would inventory all roads/trails in the JIDPA not already inventoried by BLM within 1 year of the ROD for this project; GIS data would be provided to BLM and the JIO with FGDC-compliant metadata. Operators would initiate coordination with the JIO prior to implementing this action.

- Within 6 months of the ROD for this project, Operators would provide the JIO with estimates of the average number of vehicle trips per day to a representative individual well pad and centralized completion facility (see Appendix B, Subappendix DP-A, *Transportation Plan*).

- To the extent reasonable and practical, well pad surface disturbance would not exceed 7.0 acres for parent and multi-well pads, 4.0 acres for single-well pads, and 2.0 acres for satellite well pads, unless the Operator can demonstrate to the satisfaction of the authorized officer on a case-by-case basis that the size limitation for a given pad would create a significant safety concern for the workers, the public at large, or the environment. These acreages include cut-and-fill slopes, but do not include access roads and pipelines.

- All new development and production facilities in the JIDPA would be placed at centralized locations to accommodate multiple wells, unless proven to the satisfaction of the authorized officer on a case-by-case basis that centralization of development and production facilities would not be technically or economically feasible, or that another method would create less environmental impact. The Operators would centralize existing development and production facilities to the extent economically feasible.

- Centralized fracturing processes would be required for all well pads when surface density is ≥ 1 well pad/40 acres, and recommended when well pad surface density is < 1 pad/40 acres, unless the Operator can demonstrate to the satisfaction of the authorized officer that centralized fracturing is not reasonable or technically or economically feasible, or that another well completion procedure would create less surface impact.

- Where technically and economically feasible, and at the earliest possible date, Operators would begin piping produced water and condensate from all wells in the JIDPA to an appropriate condensate collection point or sales line and an appropriate produced water treatment, disposal, or centralized transportation facility.

- Operators would utilize closed drilling systems (no reserve pits) for all wells unless proven to the satisfaction of the authorized officer on a case-by-case basis that closed drilling systems would not be technologically or economically feasible. If reserve pits are approved, Operators would remove/vacuum fluids from reserve pits within 60 days of all wells on the pad being put into production. If this timeframe is infeasible on a particular site, the Operators would notify the JIO and fluids would be removed as soon as practical.

- No surface occupancy would be allowed within 300 feet of Sand Draw.

Air Quality

- Operators would utilize flareless completions for all wells within the JIDPA unless proven to the satisfaction of the authorized officer on a case-by-case basis that flareless completion operations would not be technically or economically feasible or would be unsafe, and that flaring completion is permitted by WDEQ.

- Tier II or equivalent diesel engine emission technologies would be required for all drill rigs at the earliest possible date.

- Operators would periodically demonstrate that potential impacts to visibility in the Bridger Wilderness from this project are less than or equal to the potential visibility impact level of concern.

Water Resources/Soils

- Operators would provide copies of their Spill Prevention, Control, and Countermeasure (SPCC) plans and Storm Water Pollution Prevention Plans (SWPPPs) to the BLM upon request.

- Stormwater and snowmelt water would be held on the JIDPA for as long as possible to allow for infiltration and to reduce surface flow velocity and associated sediment loads using geofabrics, jute netting, spreader dikes, retention ponds, additional armoring of existing watercourses, or other appropriate techniques.

Noise

- Operators would monitor the representative noise levels of drilling, cementing, and completion operations 30 feet from the well pad boundary and provide monitoring data to the JIO for the establishment of noise impact charts.

- Operators would monitor noise at noise-sensitive resource locations, as determined by the JIO, and annually report results to the JIO.

Biological Resources

- Operators would inventory greater sage-grouse seasonal habitats within the JIDPA not already inventoried by BLM or WGFD within 1 year after signing of the ROD for this project; GIS data would be provided to the JIO with FGDC-compliant metadata. Operators would initiate coordination with the JIO prior to implementing this action.

- Compressor stations would be sited at least 2 miles away from greater sage-grouse leks and no closer than ½ mile to an active raptor nest.

- Operators would coordinate with the JIO to review and revise the Jonah Wildlife Monitoring and Protection Plan, and include a wildlife/habitat mitigation plan, within 1 year of the ROD for this project.

- Operators would complete surveys of soils and vegetation types throughout the JIDPA in coordination with the JIO, and provide survey results to BLM and the JIO in a digital, 1:24,000-scale format with FGDC-compliant metadata. Operators would initiate coordination with the JIO prior to implementing this action.

- Operators would maximize interim (production phase) well pad reclamation by recontouring to the drilling rig anchor pins and reclaiming/revegetating to within 20 feet of the wellhead, or to within 20 feet of the wellhead, facilities, tanks, and spill containment structures on those pads with production facilities. The initiation of interim reclamation would commence immediately after the last well scheduled on a pad is put into production. In the event that more than 1 year would lapse between the drilling of wells on a pad, the authorized officer may require temporary site stabilization measures.

- Operators would submit interim and long-term reclamation plans for their respective areas of operation to the JIO for approval no later than 1 year from the date of the ROD for this project. Site-specific reclamation plans would be incorporated into all Surface Use Plans for APDs and Plans of Development for ROWs.
- Operators would accelerate reclamation of disturbed areas using innovative seed mixtures and application techniques, supplementing natural precipitation with sprinkler irrigation at key times, and/or other practices as approved by the JIO.

- Operators would undertake aggressive invasive plant species and noxious weed control or removal in disturbed areas, be responsible for weed control on all disturbed areas in the JIDPA, and be responsible for consultation with the authorized officer and/or local authorities for acceptable weed control methods. Where applicable, a "Pesticide Use Proposal" (Form WY-04-9222-1), surfactant material safety data sheet(s), and maps and/or legal descriptions of the area to be treated would be submitted by the Operator to the JIO no later than December 1 for use the following spring/summer.

- Minimum reclamation requirements would be:

  - establishment of viable site-stabilizing plant growth, as determined by the authorized officer, within 1 year of initiation of reclamation; site-stabilizing plant growth would consist of indigenous species.

  - establishment within 5 years of initiation of reclamation of at least 50%, and within 8 years of initiation of reclamation at least 80%, of indigenous vegetative basal cover/density and species composition to maintain soil stability and provide nutritional value, palatability, and vegetative structure (i.e., vegetative habitat function).

- Wildlife habitat evaluations using Habitat Evaluation Procedures (HEP) and Habitat Suitability Indices (HSI) for appropriate species would be developed and used to evaluate impacts to habitat and the effectiveness of reclamation and mitigation.

- Operators would participate in and support published research that evaluates impacts from development and the effectiveness of applied mitigations.

Livestock/Grazing Management

- In coordination with the JIO, Operators would monitor forage utilization on reclaimed areas throughout project development and into the full production phase.

Visual Resources

- New production facilities would be painted a non-contrasting color which is harmonious with the surrounding landscape (i.e., shale green, unless otherwise specified by BLM on a case-by-case basis); existing production facilities would be painted that color at the earliest opportunity, and no later than when facilities are due for routine repainting. Operators would develop a visual resource monitoring plan to ensure long-term compliance with stated visual resource management (VRM) objectives.

2.4.5.3 Site-Specific Conditions of Approval, Mitigation Monitoring, Surveying, and Best Management Practices

Based on the appropriate environmental review or assessment for individual APDs and ROW applications, the BLM may require the following COAs, mitigations, and BMPs. BLM would consider annual JIO recommendations to adjust these requirements to meet field development and production objectives throughout the LOP.

- Implement additional air quality protection measures such as reduced development rates, reduced flaring, use of selective or non-selective catalytic reduction on internal combustion engines, increased diameter pipelines, and/or increased water or magnesium chloride applications or other treatments (gravel, paving) on all surface disturbances, including resource roads and well pads.
- Convert resource roads to two-track roads during interim reclamation where environmentally sound, practical, safe, and where capable of providing the level of access necessary to maintain and produce the well.
- Contour spoil piles to approximate the surrounding topography and apply soil stabilization practices to spoil piles.
- Avoid prairie dog towns where practical to maintain burrowing owl habitat.
- Institute nighttime lighting/glare restrictions (e.g., install light shades/hoods, directional lighting, colored lights, wattage limits, motion detectors; extinguish all unnecessary lighting during non-working hours).
- Monitor effectiveness of night lighting mitigation measures in coordination with the JIO.

2.5 SUMMARY OF ENVIRONMENTAL IMPACTS

Table 2.6 provides a brief comparison of potential impacts to key project issues (see Section 2.1) across alternatives. Additional detail is provided in the summary of impacts table in Appendix G, and in the detailed impact assessments provided in Chapter 4.

Table 2.6. Brief Comparison of Impacts to Key Issues Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Key Issue	No Action	Proposed Action	A	B	Preferred[2]
Disturbance Volume					
Total Acres Surface Disturbance	4,209	20,409	20,409	7,431	14,030–20,334
Total Acres New Disturbance	0	16,200	16,200	3,297	9,821–16,125
LOP Acres Surface Disturbance	1,409	6,040	6,040	2,602	4,267–6,020
Project Duration/Pace/Economics					
LOP (years)	63	76	76	105	76
Wells Developed Per Year	0	250	250	75	250
New Worker Years (development and production)	0	16,863	16,863	16,863	16,863
Total Taxes and Royalties (millions)	2,335	6,077	6,239	4,881	6,077
Sublette County Share (millions)	742	1,839	1,892	1,446	1,824
Air Quality/Visibility per year					
Additional Days of Impairment per year at Bridger Wilderness	0	10	10	4	3
Additional Days of Impairment per year at Pinedale	0	3	3	1	1
Habitat Loss All Species					
Direct habitat loss for greater sage-grouse, pronghorn antelope, and other wildlife would be related to surface disturbance and project duration as listed above. Most wildlife species would likely avoid development areas under all alternatives.					
Indirect habitat loss for greater sage-grouse, pronghorn antelope, and other wildlife would be related to total surface disturbance (and its location), volume of human presence (worker-years), and project duration as listed above.					
Total Well Pads	497	3,597	3,597	497	3,597
New Roads (miles)	237	710	710	245	488–710
Average Daily Traffic Volume[3] (round trips to and from the JIDPA per day)	45–88	312–610	312–610	312–610	312–610
Mineral Resource Recovery					
Natural Gas (billion cubic feet)	3,366	7,947	8,191	6,124	4,824[4]–7,947
Condensate (million barrels)	32	76	78	58	46–76
BLM Inspection and Enforcement					
BLM inspection and enforcement capability would be dependent upon management requirements and annual budgets and priorities.					
Compensatory Mitigation					
Hypothetical Value (million $)	0	28.5	28.5	0	5.5–28.5

1 Further summary detail is provided in Appendix G, Summary of Impacts; detailed discussion of impacts to all resources is provided in Chapter 4.
2 Application of alternative-specific COAs, BMPs, and other mitigation and monitoring may reduce impact levels from those shown in this table.
3 Traffic volumes would be highest during development.
4 Assumes no successful reclamation to BLM standards is achieved, and therefore no additional surface disturbance credit is granted.

CHAPTER 3 — AFFECTED ENVIRONMENT

This chapter describes existing conditions of the physical, biological, cultural, socioeconomic, and visual resources in the JIDPA and identifies associated resource-specific cumulative impact assessment areas (CIAAs). The resources and their respective CIAAs addressed in this EIS were identified during past Jonah project NEPA analyses, scoping for this project, and/or Interdisciplinary Team (IDT) reviews.

Critical elements of the human environment (BLM 1988a, 1999a), their status in the JIDPA, and their potential to be affected by the proposed project are listed in Table 3.1. Three critical elements (areas of critical environmental concern [ACECs], prime and unique farmlands, and wild and scenic rivers) are not present and would not be affected, so are not addressed further. Other critical elements of the human environment may potentially be affected and are addressed. In addition to the critical elements, this EIS discusses existing conditions and potential project effects (see Chapter 4) on topography; mineral resources; geologic hazards; paleontological resources; soils; noise, and odor; biological resources; socioeconomics; land use, including status, livestock/grazing management, recreation, and transportation; and visual resources.

Table 3.1. Critical Elements of the Human Environment, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005

Element[1]	Status on JIDPA	Addressed in this EIS
Air quality	Potentially affected	Yes
Areas of Critical Environmental Concern	Not present	No
Cultural resources	Potentially affected	Yes
Environmental justice	Not affected	Yes
Farmlands (prime or unique)	Not present	No
Floodplains	Potentially affected	Yes
Native American religious concerns	Potentially affected	Yes
Noxious weeds	Potentially affected	Yes
Threatened and endangered species	Potentially affected	Yes
Wastes, hazardous or solid	Potentially affected	Yes
Water quality (surface and ground water)	Potentially affected	Yes
Wetlands/riparian zones	Potentially affected	Yes
Wild and scenic Rivers	Not present	No
Wilderness	Not present	Yes

[1] Adapted from BLM (1988a, 1999a).

Table 3.2 lists the CIAAs for each resource, and CIAA maps are presented in specific resource sections of this EIS chapter. Existing disturbance in the JIDPA and CIAAs was estimated using existing digital geographic information system (GIS) data for roads, oil and gas wells, land cover, residential areas, surface water resources, wetlands, and watershed boundaries. Oil and gas well

Table 3.2. Cumulative Impact Assessment Areas, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005

Resource	CIAA[1]
Air quality	Project area and nearby Class I and sensitive Class II areas[2]
Topography	Project-affected sixth-level watersheds
Geology	
Mineral resources	Combined Jonah, Jonah II, and Jonah Infill Project areas
Geologic hazards	Combined Jonah, Jonah II, and Jonah Infill Project areas
Paleontological resources	Paleontological/cultural resource CIAA
Soils	Project-affected sixth-level watersheds
Water resources	
Surface water	Project-affected sixth-level watersheds
Groundwater	Project area and associated draw-down area
Odor	Project area and 2-mile buffer
Noise	Project area and 20-mile buffer
Vegetation	
General	Project-affected sixth-level watersheds
Wetlands/riparian areas	Project-affected sixth-level watersheds
Wildlife and fisheries	
Big game	Project-affected ranges and migration corridors for the Sublette Pronghorn Antelope Herd
Greater sage-grouse	Northern portion of Upland Game Bird Management Area 7
Raptors	Raptor CIAA
Fisheries	Project-affected sixth-level watersheds
Other species	Jonah Wildlife Study Area
Wild horses	Little Colorado Herd Management Area
Threatened, endangered, candidate, proposed, and BLM-sensitive species	Entire ranges for affected species; Green and Colorado River depletion area for the four endangered Colorado River fish species
Cultural resources	Paleontological/cultural resource CIAA
Socioeconomics	Counties (Lincoln, Sublette, and Sweetwater) and communities (LaBarge, Pinedale, Big Piney, Marbleton, Boulder, Eden, Farson, and Rock Springs) most likely to be impacted by the proposed Project
Land use	
Agricultural/rangeland	Project-affected grazing allotments
Minerals extraction	Combined Jonah, Jonah II, and Jonah Infill Project areas
Recreation	Recreation CIAA
Land status and prior rights	Project area and leases that extend beyond Project area
Visual resources	Visual resource CIAA

[1] CIAA = cumulative impact assessment area; see resource-specific sections of EIS Chapter 3 for mapped locations.
[2] Air quality emissions sources from a larger area; see Map 3.1.

and associated access road locational information was obtained from the WOGCC and BLM databases, as well as Operator-provided data. Existing development information for the JIDPA and surrounding areas was obtained from annual Jonah and Pinedale Anticline wildlife monitoring reports (TRC Mariah Associates Inc. [TRC Mariah] 2004a, 2004b) and aerial photographs of the JIDPA and surrounding areas. Big game ranges and migration routes; raptor nest and greater sage-grouse lek information; potential federally listed threatened, endangered, proposed, and candidate (TEP&C) and BLM Wyoming Sensitive (BWS) species habitat information; soils; vegetation types; general wildlife observation information; wild horse management areas; and grazing allotments information was obtained from WGFD, BLM, and Wyoming Natural Diversity Database (WyNDD) digital shapefiles and associated data files and were used to assist in describing the affected environment for these resources.

3.1 PHYSICAL RESOURCES

3.1.1 Climate

The JIDPA is located in a semiarid (dry and cold) mid-continental climate regime. The area is typified by dry windy conditions, with limited rainfall and long cold winters. The nearest long-term meteorological measurement station is at LaBarge, Wyoming (1958–2003), approximately 20 miles southwest of the JIDPA at an elevation of 6,858 feet (Western Regional Climate Center [WRCC] 2004). Variations in elevation and topography across the region result in variations in site-specific climatic conditions; therefore, site-specific conditions in the JIDPA likely vary somewhat from those reported herein.

The total annual average precipitation at LaBarge is 8.0 inches, ranging from 17.8 inches (1995) to 3.4 inches (1975). Precipitation is greatest from mid-spring to early fall, tapering off during the winter months. An average of 30.5 inches of snow falls during the year (annual high 43.6 inches in 1987). Table 3.3 shows the average monthly temperature ranges and precipitation.

Table 3.3. Mean Monthly Temperature Ranges and Total Precipitation at LaBarge, Wyoming[1]

Month	Average Monthly Low and High Temperatures (°F)		Average Precipitation (inches)
January	-1.7	30.9	0.31
February	1.0	34.6	0.34
March	13.7	43.1	0.38
April	23.4	54.0	0.81
May	32.0	64.8	1.31
June	38.9	73.6	1.03
July	43.9	83.4	0.67
August	42.3	81.6	0.88
September	33.2	70.8	0.77
October	22.4	59.2	0.57
November	10.5	41.4	0.47
December	-0.9	31.0	0.46
Annual Average	21.6	55.7	8.0

[1] Source: WRCC 2004.

The region has cool temperatures, with average daily temperature (in degrees Fahrenheit [ºF]) ranging between -1.7ºF and 30.9ºF in January to between 43.9ºF and 83.4ºF in July. Extreme temperatures have ranged from -52ºF (1990) to 96ºF (2002). The frost-free period generally occurs from mid-May to mid-September.

The region is subject to strong and gusty winds, reflecting channeling and mountain valley flows due to complex terrain. During the winter months, strong winds are often accompanied by snow, producing blizzard conditions. The closest comprehensive wind measurements were collected in the JIDPA at a meteorological station operated by BP America from 1999 through 2003. A wind rose showing the frequency distribution of wind speed and direction in the JIDPA from 1999–2002 is provided in Figure 3.1. Table 3.4 provides the wind direction distribution in a tabular format. From this information, it is evident that winds in the JIDPA originate from the west to northwest approximately 40% of the time. The annual mean wind speed is 11.3 miles per hour (mph).

Table 3.4. Wind Direction Frequency Distribution, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006[1]

Wind Direction	Occurrence (%)
N	5.1
NNE	3.8
NE	3.6
ENE	4.1
E	3.9
ESE	3.4
SE	2.9
SSE	2.8
S	3.9
SSW	5.0
SW	6.0
WSW	6.6
W	10.2
WNW	16.0
NW	13.9
NNW	8.8

[1] Source: BP America (2004).

Table 3.5 shows the frequency distribution of wind speeds in the JIDPA, and Table 3.6 shows the atmospheric stability class. The atmospheric stability class is the measure of atmospheric turbulence, which directly affects pollutant dispersion. The stability classes are divided into six categories designated “A” (unstable) through “F” (very stable). The “D” (neutral) stability class occurs more than half of the time. Unstable conditions are associated with good dispersion (about 20%), neutral conditions with fair dispersions (61%), and poor dispersion with stable conditions (19%).

Table 3.5. Wind Speed Distribution, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006[1]

Wind Speed (mph)	Occurrence (%)
0 – 4.0	8.9
4.0 – 7.5	25.8
7.5 – 12.1	28.1
12.1 – 19.0	24.4
19.0 – 24.7	7.4
Greater than 24.7	5.4

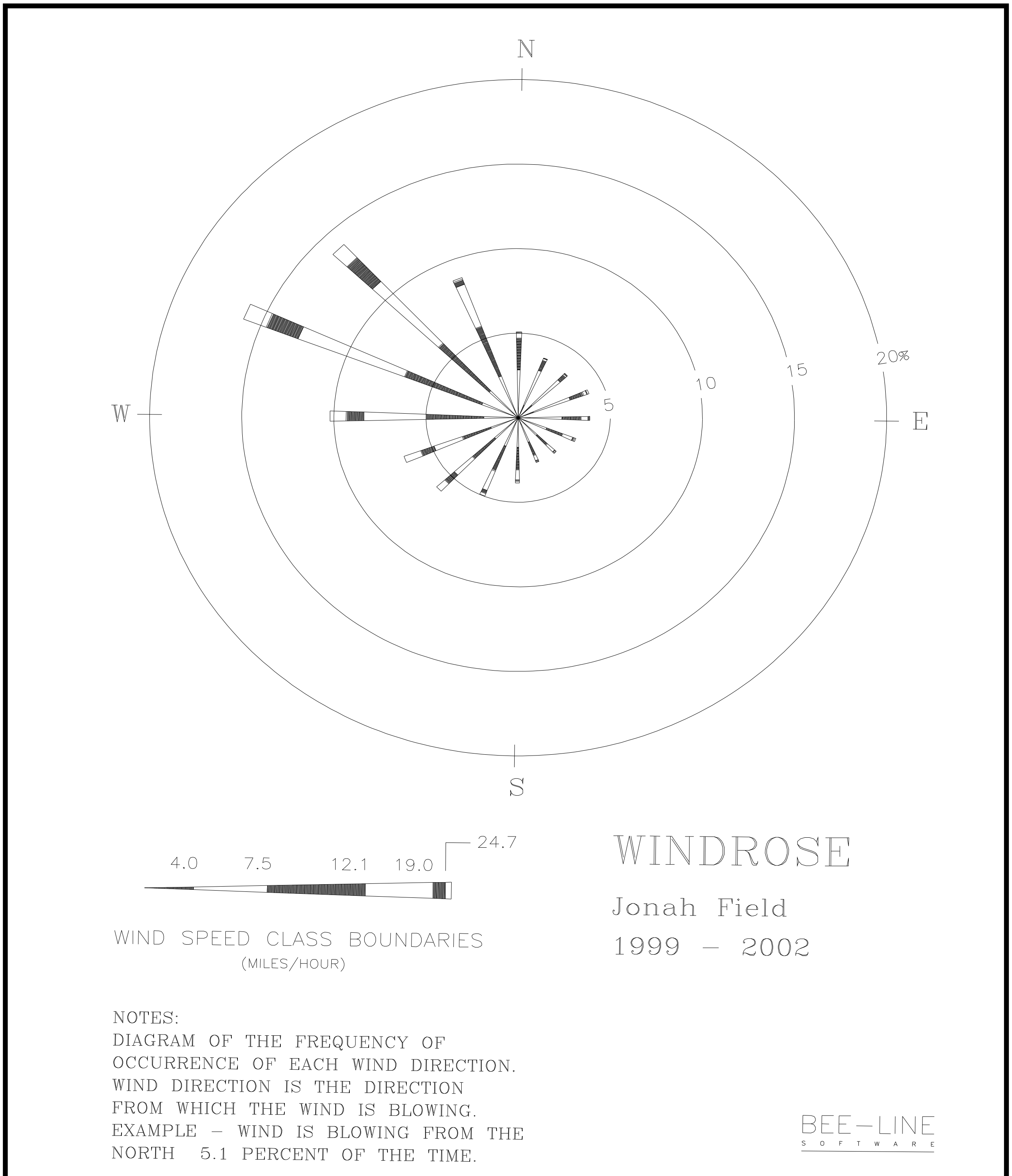
[1] Source: BP America (2004).

The frequency and strength of winds greatly affects the dispersion and transport of air pollutants. Because of the strong winds in the region, the potential for atmospheric dispersion is relatively high (although nighttime cooling enhances stable air, inhibiting air pollutant mixing and transport).

An assessment of project impacts to climate is beyond the scope of this analysis; therefore climate is not discussed further in this EIS.

3.1.2 Air Quality

Components of air quality include concentration, visibility, and atmospheric deposition.



Source: BP America (2004).

Figure 3.1. Wind Rose, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005.

3.1.2.1 Concentrations

Table 3.6. Atmospheric Stability Class Distribution, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2005[1]

Class[2]	Frequency (%)
A	2.3
B	5.9
C	12.0
D	60.8
E	15.2
F	3.7

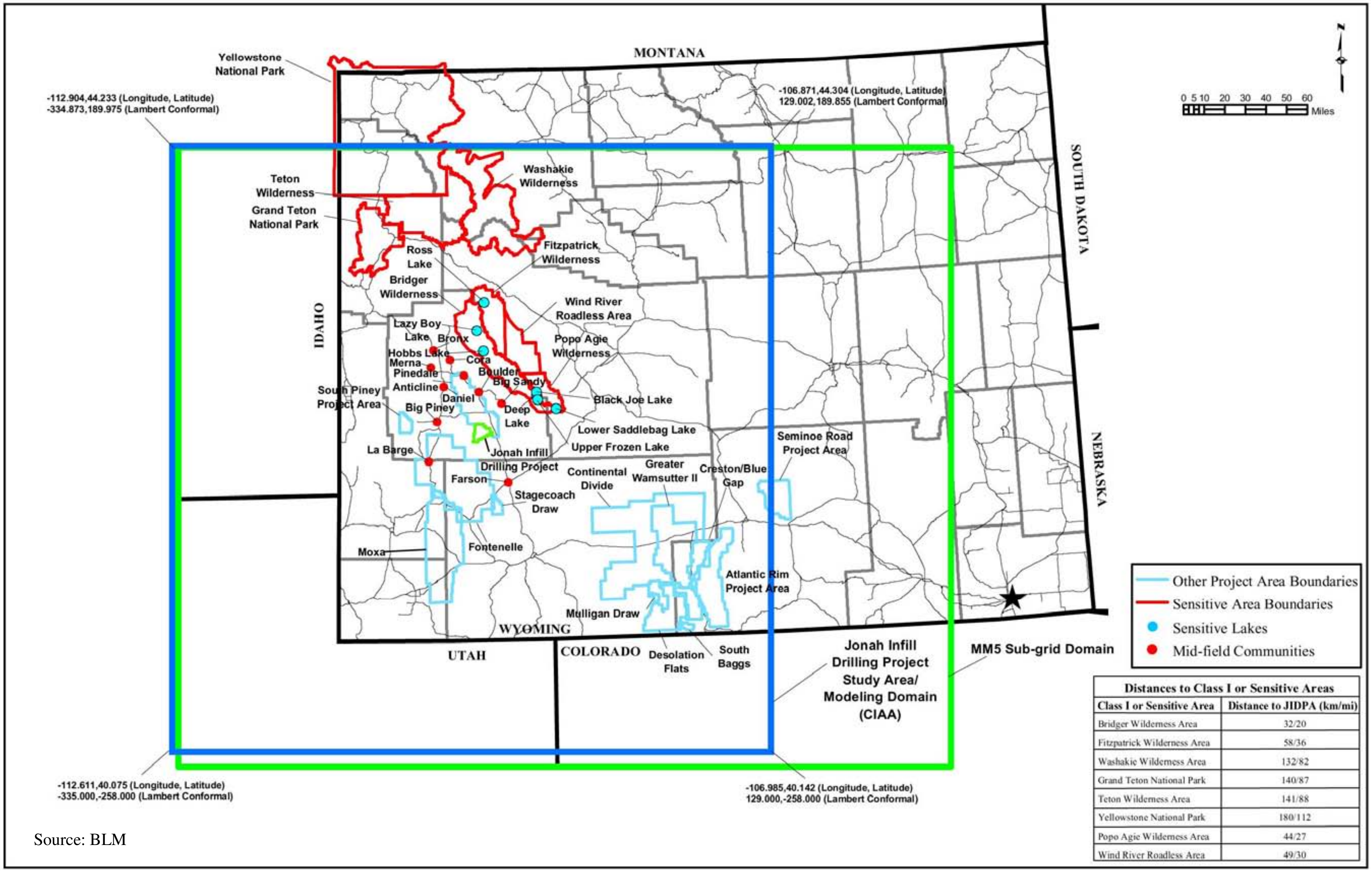
1 Source: BP America (2004).
2 A = very unstable; B = unstable; C = slightly unstable; D = neutral; E = stable; F = very stable.

The Wyoming Ambient Air Quality Standards (WAAQS) and National Ambient Air Quality Standards (NAAQS) are health-based criteria for the maximum acceptable concentrations of specific air pollutants at locations to which the public has access. Although specific air quality monitoring was not initiated within the JIDPA until 2005, air quality monitoring for the most relevant pollutants has been conducted and determined to be representative of the CIAA (Map 3.1). Air pollutants measured for which ambient air quality standards exist include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns in effective diameter (PM_{10}), particulate matter less than 2.5 microns in effective diameter ($PM_{2.5}$), and sulfur dioxide (SO_2). Representative background concentrations for these pollutants are compared to the WAAQS and NAAQS and Prevention of Significant Deterioration (PSD) Class I and II Increments in Table 3.7.

As shown in Table 3.7, regional background values are below established standards, and all areas within the CIAA are designated as attainment for all criteria pollutants. The Federal PSD regulations adopted and implemented by WDEQ/AQD limit the amount by which pollution levels are allowed to increase above historical levels, thus protecting against specific increases in pollution levels in areas with historically good air quality. The increases allowed under the program vary with location. Class I areas have the most stringent limits, while Class II areas have somewhat less stringent limitations (see Table 3.7). Six PSD Class I areas are identified as sensitive areas within the CIAA: the Bridger, Fitzpatrick, Teton, and Washakie Wilderness Areas, as well as Grand Teton and Yellowstone National Parks (see Map 3.1). The remainder of the CIAA is classified PSD Class II. The Popo Agie Wilderness Area and the Wind River Roadless Area are PSD Class II areas that have been identified as additional sensitive areas occurring within the CIAA for air quality.

3.1.2.2 Visibility

The 1977 Clean Air Act amendments declared "as a National Goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas in which impairment results from manmade air pollution." The Clean Air Act gives federal land managers the affirmative responsibility, but no regulatory authority, to protect air quality-related values (AQRVs), including visibility. Regulations have since been established by EPA to protect visibility within Class I areas. Residents of the Pinedale area consider visibility impairment to be a major concern. Visibility impacts within Class II areas such as the Sublette County towns of Merna, Pinedale, and Boulder are categorized in this analysis as the mid-field area of study. Visibility or other AQRV impacts within these Class II areas are neither monitored nor regulated by state or federal agencies.



Distances to Class I or Sensitive Areas	
Class I or Sensitive Area	**Distance to JIDPA (km/mi)**
Bridger Wilderness Area	32/20
Fitzpatrick Wilderness Area	58/36
Washakie Wilderness Area	132/82
Grand Teton National Park	140/87
Teton Wilderness Area	141/88
Yellowstone National Park	180/112
Popo Agie Wilderness Area	44/27
Wind River Roadless Area	49/30

Map 3.1. Air Quality Modeling Domain (Cumulative Impact Assessment Area) Depicting Class I and Other Sensitive Areas and Lakes, Jonah Infill Drilling Project, 2005.

Table 3.7. Air Pollutant Background Concentrations, Wyoming and National Ambient Air Quality Standards, and Prevention of Significant Deterioration (PSD) Increments (µg/m^3)

Pollutant/ Averaging Time	Measured Background Concentration	Wyoming and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline[1]	
			PSD Class I	PSD Class II
Carbon monoxide (CO)[2]				
1-hour	3,336	40,000	n/a	n/a
8-hour	1,381	10,000	n/a	n/a
Nitrogen dioxide (NO_2)[3]				
Annual	3.4	100	2.5	25
Ozone[4]				
1-hour	169	235	n/a	n/a
8-hour	147	157	n/a	n/a
Particulate matter (PM_{10})[5]				
24-hour	33	150	8	30
Annual	16	50	4	17
Particulate matter ($PM_{2.5}$)[5]				
24-hour	13	65	n/a	n/a
Annual	5	15	n/a	n/a
Sulfur dioxide (SO_2)[6]				
3-hour (National)	132	1,300	25	512
24-hour (National)	43	365	5	91
24-hour (Wyoming)	43	260	5	91
Annual (National)	9	80	2	20
Annual (Wyoming)	9	60	2	20

1 n/a = not applicable.
2 Background data collected by Amoco at Ryckman Creek for an 8-month period during 1978–1979, summarized for the Riley Ridge project (BLM 1983).
3 Background data collected at Green River Basin Visibility Study site, Green River, Wyoming, during period January–December 2001 (Air Resource Specialists [ARS] 2002).
4 Background data collected at Green River Basin Visibility Study site, Green River, Wyoming, during period June 10, 1998, through December 31, 2001 (ARS 2002).
5 Background data collected by WDEQ/Air Quality Division (AQD) at the Emerson Building, Cheyenne, Wyoming, in 2001. These data have been determined by WDEQ/AQD to be the most representative co-located PM_{10} and $PM_{2.5}$ data available.
6 Background data collected at the LaBarge Study Area/Northwest Pipeline Craven Creek site in 1982-1983.

There are two types of visible impairment caused by emission sources: plume impairment and regional haze. Plume impairment occurs when a section of the atmosphere becomes visible due to the contrast or color difference between a discrete pollutant plume and a viewed background such as a landscape feature. Short-duration (usually less than 1–2 days) visual plumes occasionally occur from the JIDPA as a result of upset conditions occurring during flaring operations. Regional haze occurs when pollutants from more diffuse emission sources become well mixed in the atmosphere, causing a general alteration in the visual appearance of landscape features, changing the color or contrast between landscape features, or causing features of a view to disappear.

Visibility impairment is measured in terms of change in light extinction or change in deciview (dv). A dv change of 1 to 2 (equivalent to a 10% to 20% change in extinction) represents a small but perceptible change in visibility. Visual range, referred to as standard visual range (SVR), is the farthest distance at which an observer can just see a black object viewed against the horizon sky. The larger the SVR, the cleaner the air. Visibility within the JIDPA air quality CIAA is considered very good, with an average SVR of over 93.2 miles (150.0 kilometers) (Malm 2000).

Visibility and atmospheric deposition monitoring is conducted within Class I areas. In 1985, the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring program was initiated to establish current visibility conditions, to track visibility changes, to establish long-term trends, and to determine the causal mechanisms of visibility impairment in Class I areas.

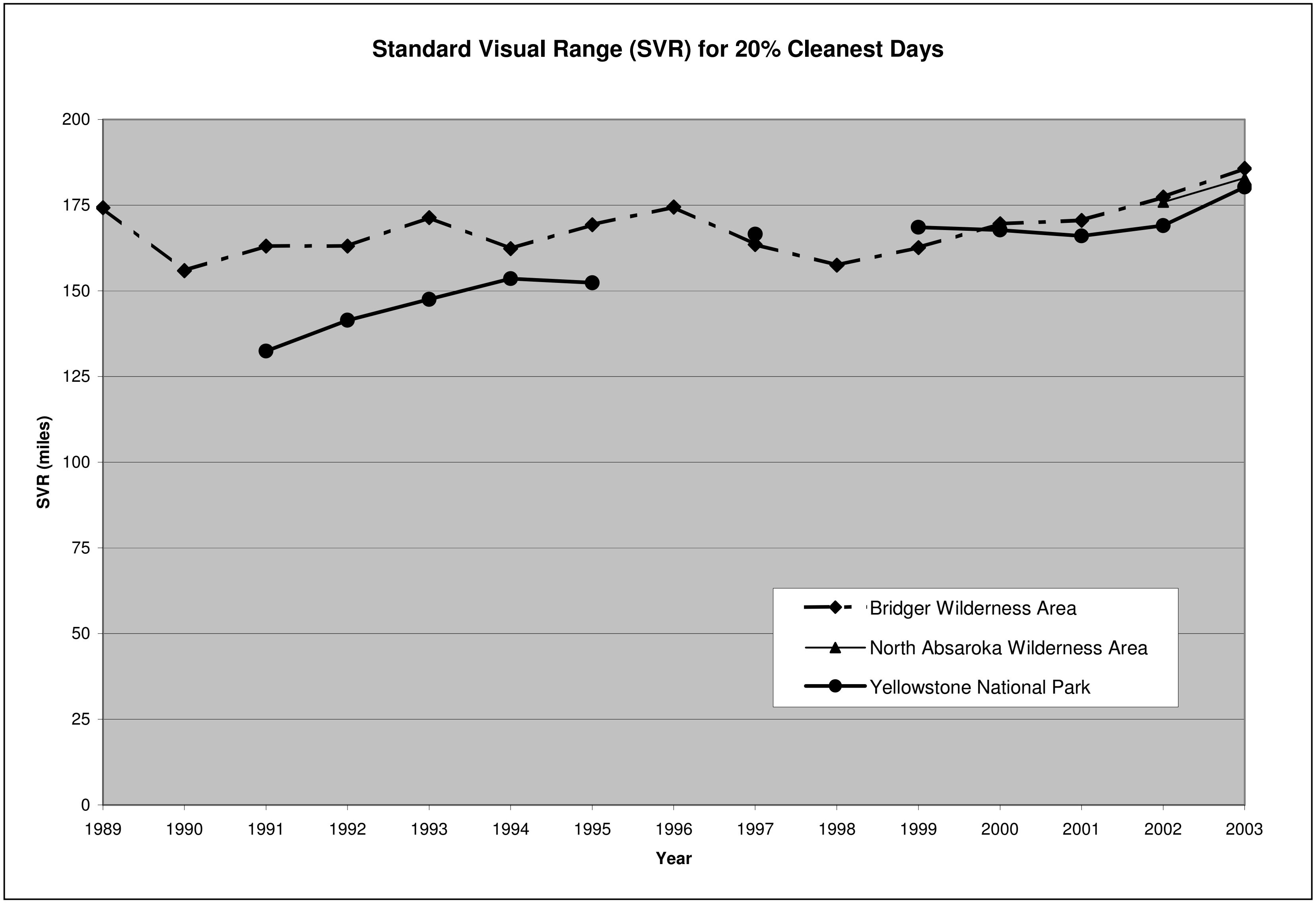
The Bridger Wilderness Area, North Absaroka Wilderness Area, and Yellowstone National Park IMPROVE sites are the closest such sites to the JIDPA. Data have been collected near the Bridger Wilderness Area and Yellowstone National Park sites since 1989, and at the North Absaroka Wilderness Area since 2000. Figures 3.2, 3.3, and 3.4 present summaries of visibility conditions at the IMPROVE sites through 2003 for the cleanest days (20th percentile best visibility days), for average conditions, and for the haziest days (20th percentile haziest visibility days), respectively (IMPROVE 2005). These data are presented in SVR and were reconstructed from monitored aerosol (suspended liquid or solid particles) data.

3.1.2.3 Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and it is reported as the mass of material deposited on an area per year (kg/ha-yr). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of pollutants). Background wet and dry atmospheric deposition impacts have been monitored at the National Acid Deposition Program (NADP) National Trends Network (NTN) (wet deposition) and Clean Air Status and Trends Network (CASTNET) (dry deposition) station near Pinedale, Wyoming. Total annual deposition (wet and dry) reported as total nitrogen and total sulfur deposition for this site for the monitoring period of record through 2003 are provided in Figures 3.5 and 3.6, respectively.

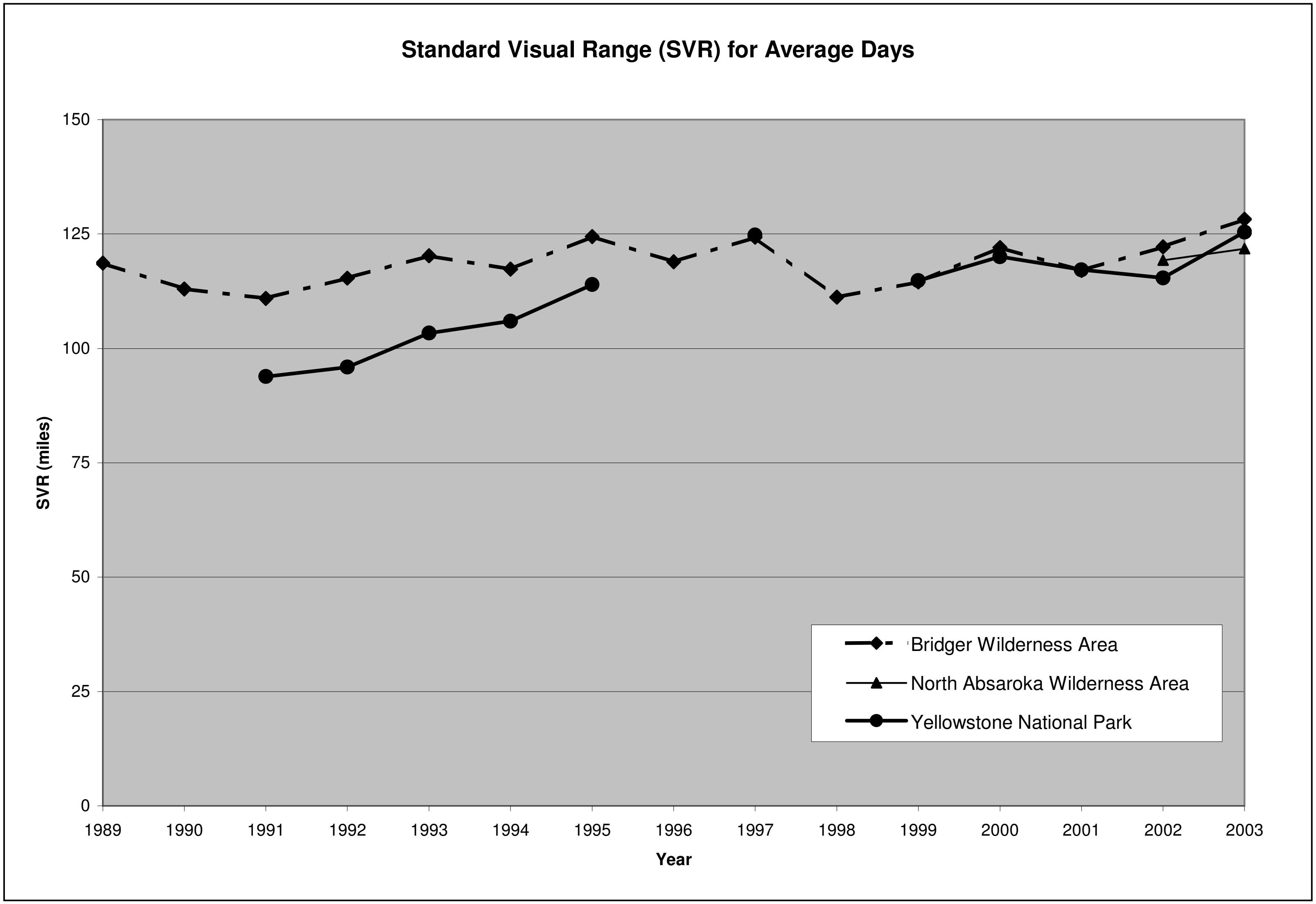
Total deposition levels of concern (LOC) have been estimated for several areas, including the Bridger Wilderness Area (U.S. Forest Service [USFS] 1989). The “red line” LOC represents an estimate of the total pollutant loadings that each wilderness can tolerate. Total loadings above these values suggest that the land manager recommends a reduction of emissions from new sources unless data are available to indicate that no AQRVs in the Class I area are likely to be adversely affected. The “green line” LOC represents the total pollution loadings (current plus proposed new source contribution) below which a land manager can recommend a permit be issued for a new source, unless data are available that indicate otherwise. The USFS has indicated that the current green line values are set too high (Caplan pers. comm.). Cumulative impacts plus background are compared to these LOCs. The Bridger Wilderness nitrogen deposition red line LOC is 10 kg/ha-yr and nitrogen deposition green line LOC is 3–5 kg/ha-yr. The Bridger Wilderness sulfur deposition red line LOC is 20 kg/ha-yr and sulfur deposition green line is 5 kg/ha-yr. For comparison with reported deposition values, these LOCs are shown on Figures 3.5 and 3.6.

The Wyoming Air Resources Monitoring System (WARMS) has measured concentrations of nitric acid, particulate nitrate, total nitrate, particulate ammonium, sulfur dioxide, and sulfate at a station near Pinedale, Wyoming since 1999. Figures 3.7 and 3.8 present the weekly concentrations of nitrogen compounds (nitrate and ammonium) and Figures 3.9 and 3.10 present concentrations of sulfur compounds (sulfur dioxide and sulfate) near Pinedale for the monitoring period of record through 2003. These data are provided as an additional measure of the nitrogen and sulfur levels near the Bridger Wilderness. WARMS data from the network start-up period from 1999 and 2000 may be unreliable; however, they are provided for comparison purposes.



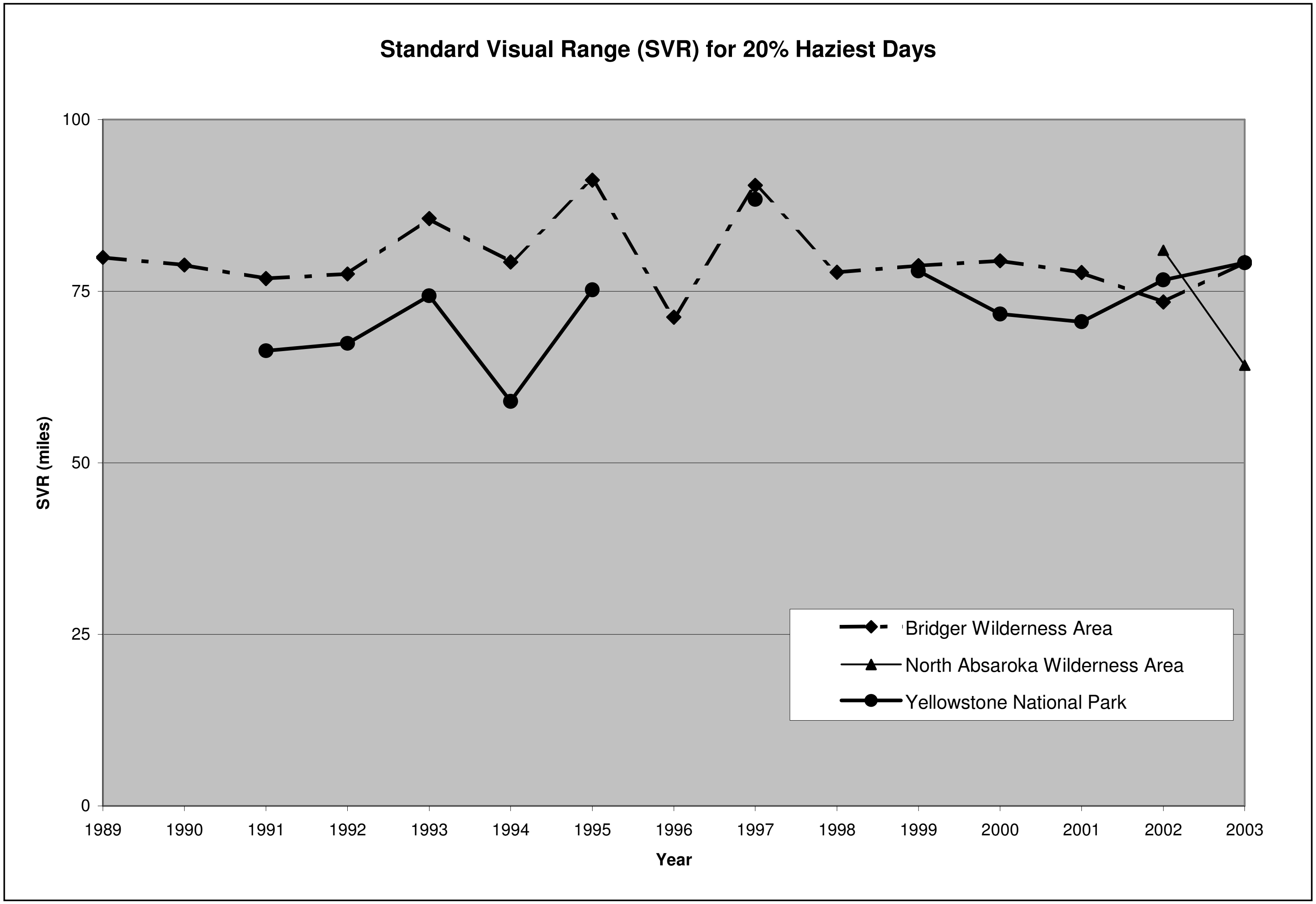
Source: IMPROVE (2005)

Figure 3.2. Standard Visual Range for 20th% Cleanest Days, Jonah Infill Drilling Project Area, Sublette County, Wyoming (IMPROVE 2005).



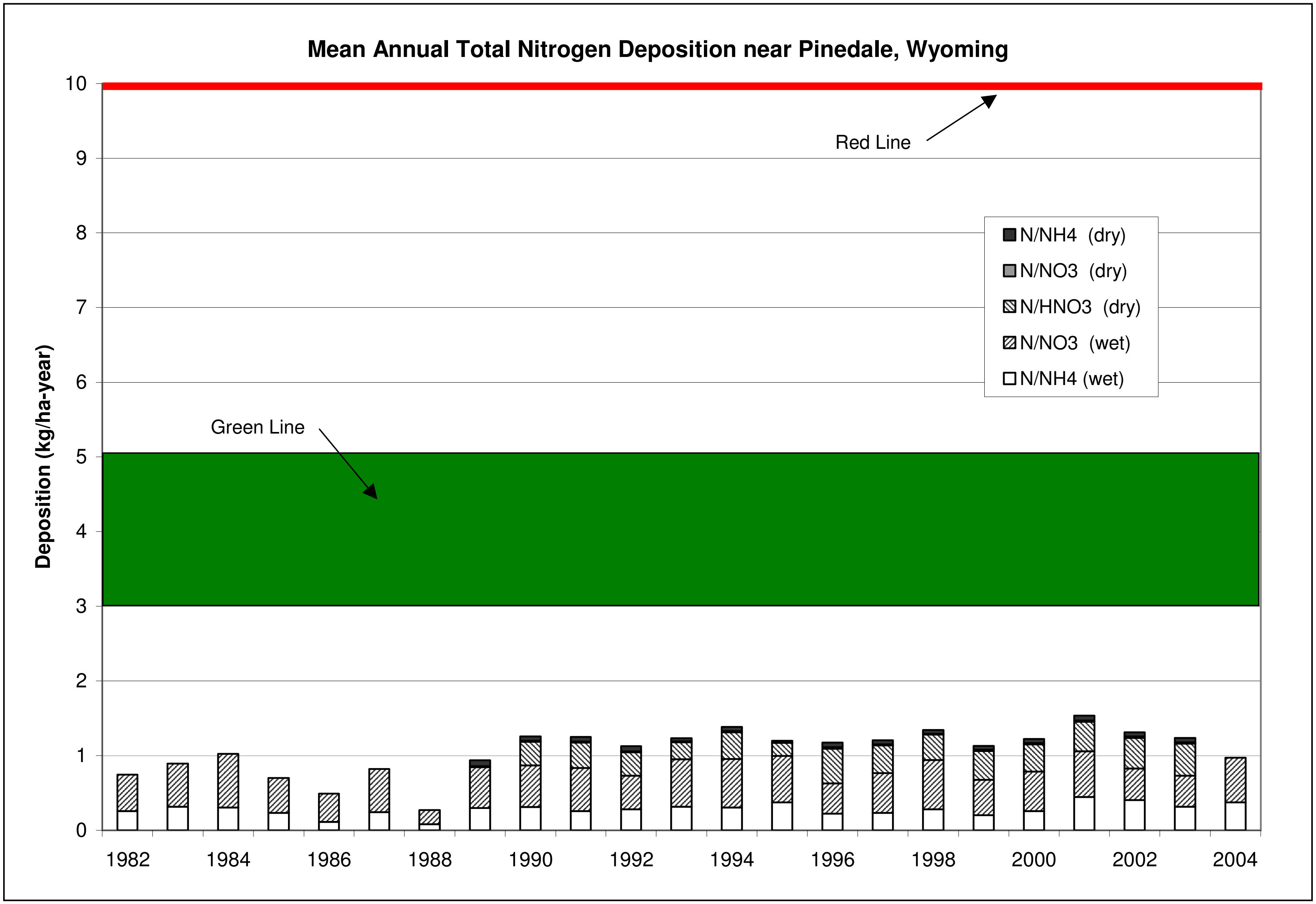
Source: IMPROVE (2005)

Figure 3.3. Standard Visual Range for Average Days, Jonah Infill Drilling Project Area, Sublette County, Wyoming (IMPROVE 2005).



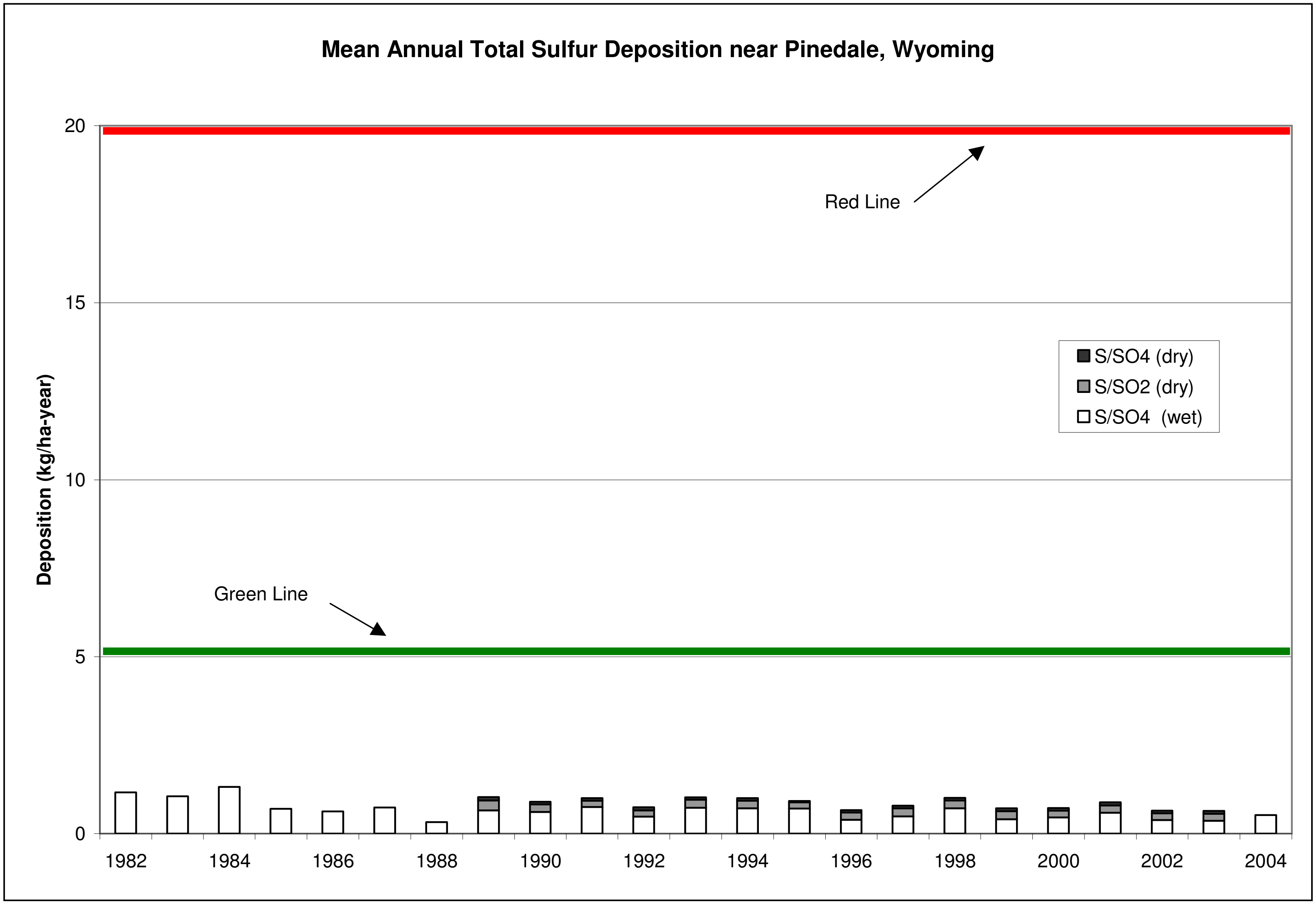
Source: IMPROVE (2005)

Figure 3.4. Standard Visual Range for 20th% Haziest Days, Jonah Infill Drilling Project Area, Sublette County, Wyoming (IMPROVE 2005).



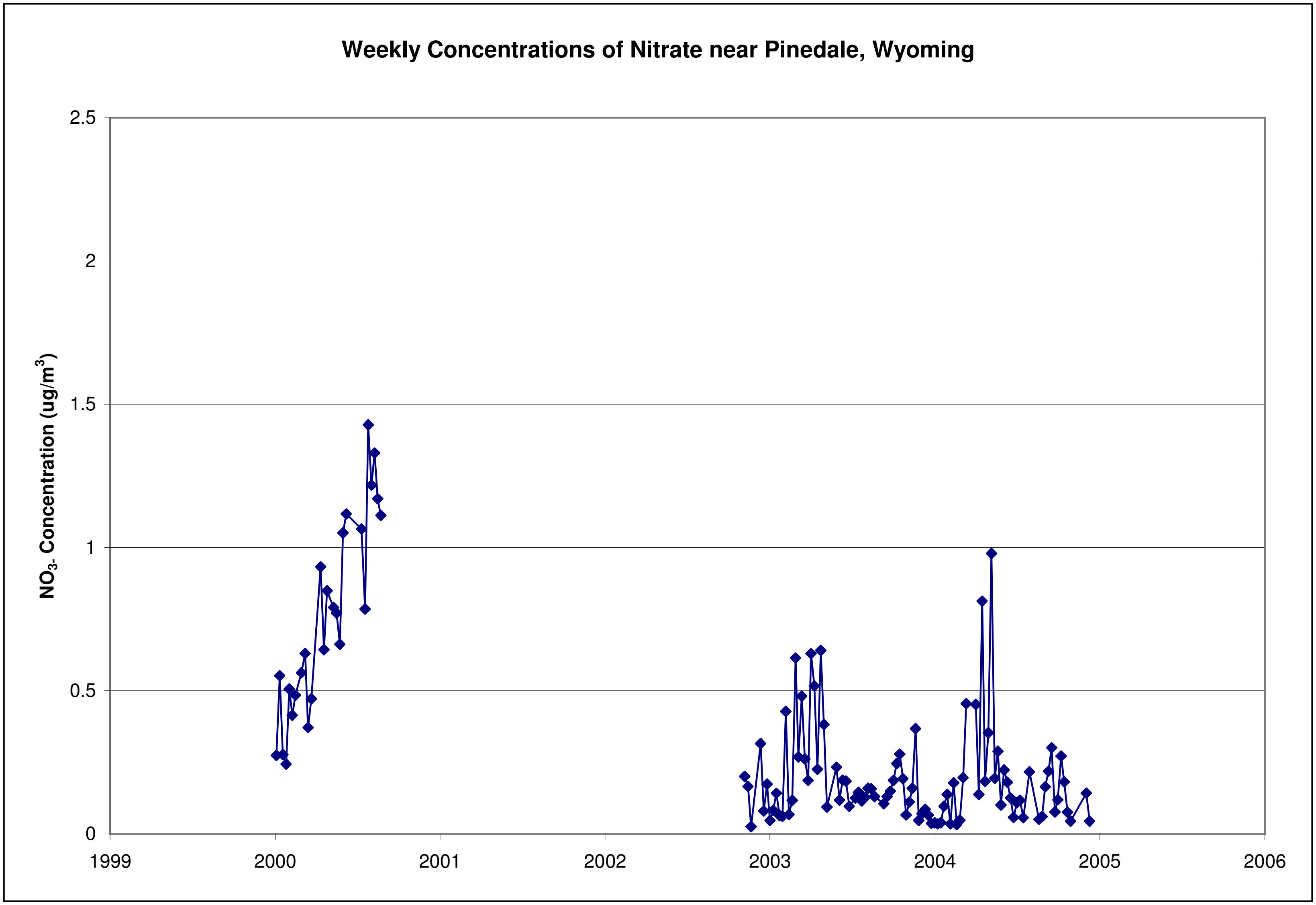
Source: BLM (Data from NADP[WY06] and CASTNET[PND165])

Figure 3.5. Mean Annual Total Nitrogen Deposition near Pinedale, Wyoming (NADP [WY06] and CASTNET [PND165]).



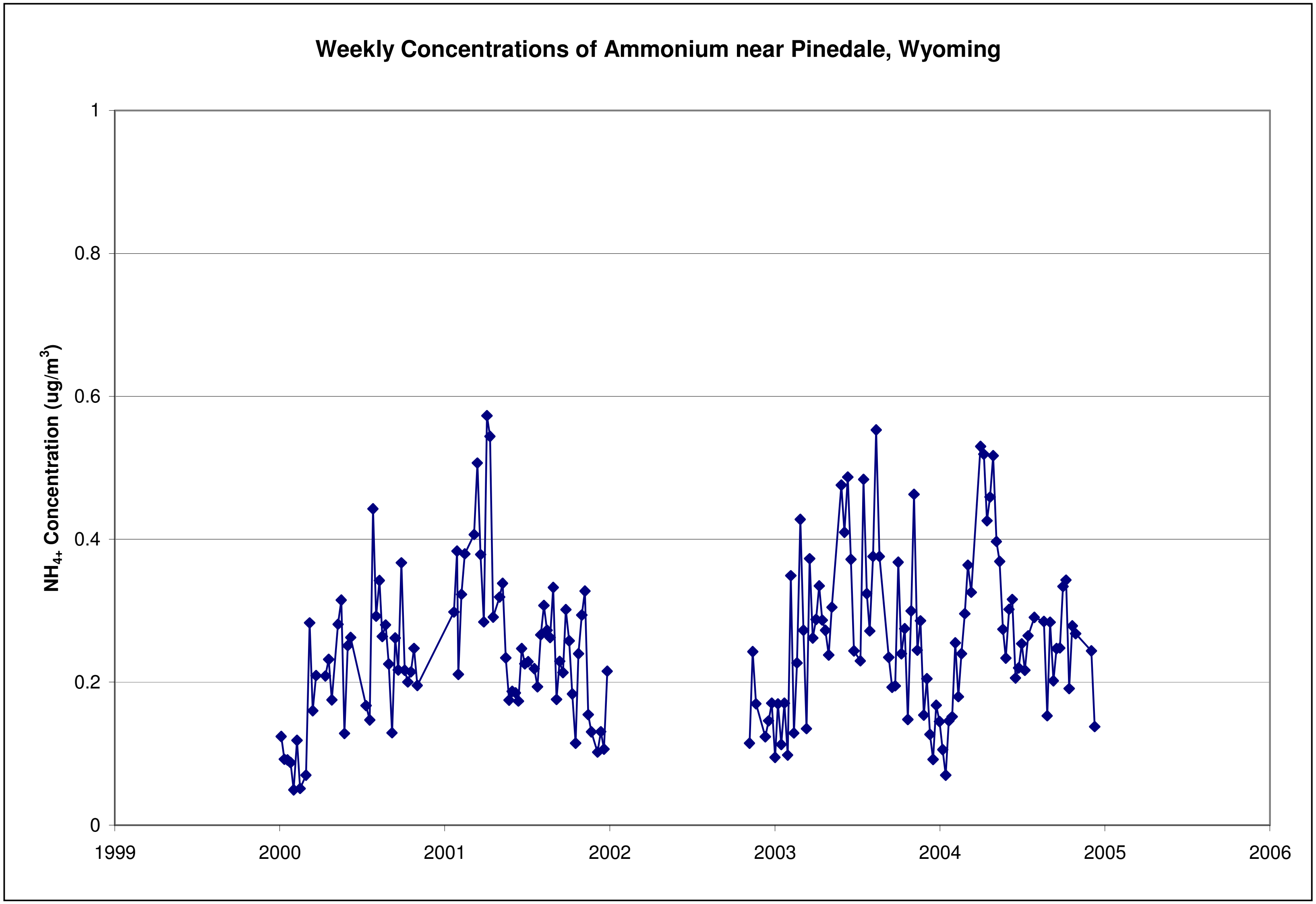
Source: BLM (Data from NADP[WY06] and CASTNET[PND165])

Figure 3.6. Mean Annual Total Sulfur Deposition near Pinedale, Wyoming (NADP [WY06] and CASTNET [PND165]).



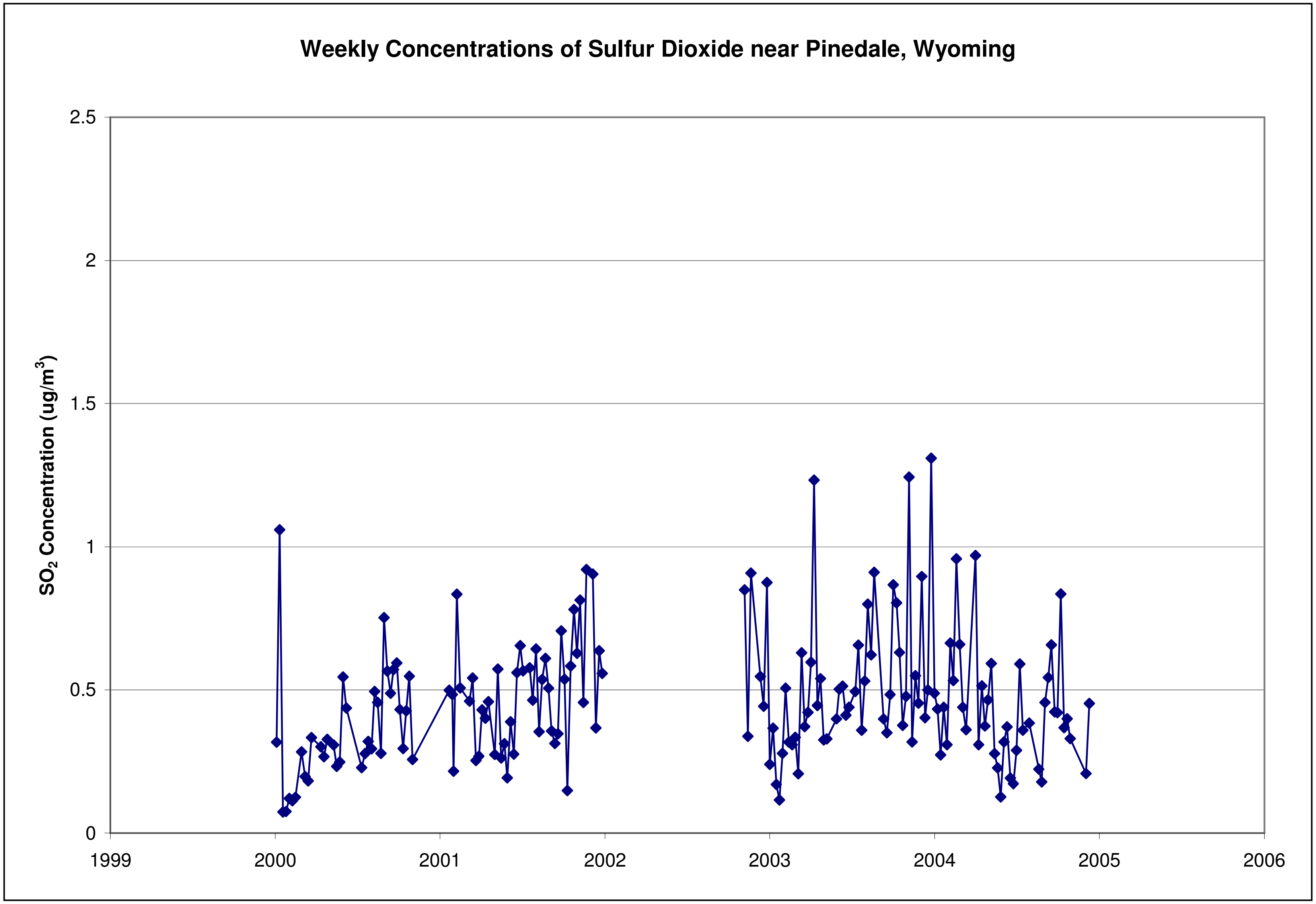
Source: BLM (Data from WARMS, Pinedale)

Figure 3.7. Weekly Concentrations of Nitrate near Pinedale, Wyoming (WARMS, Pinedale).



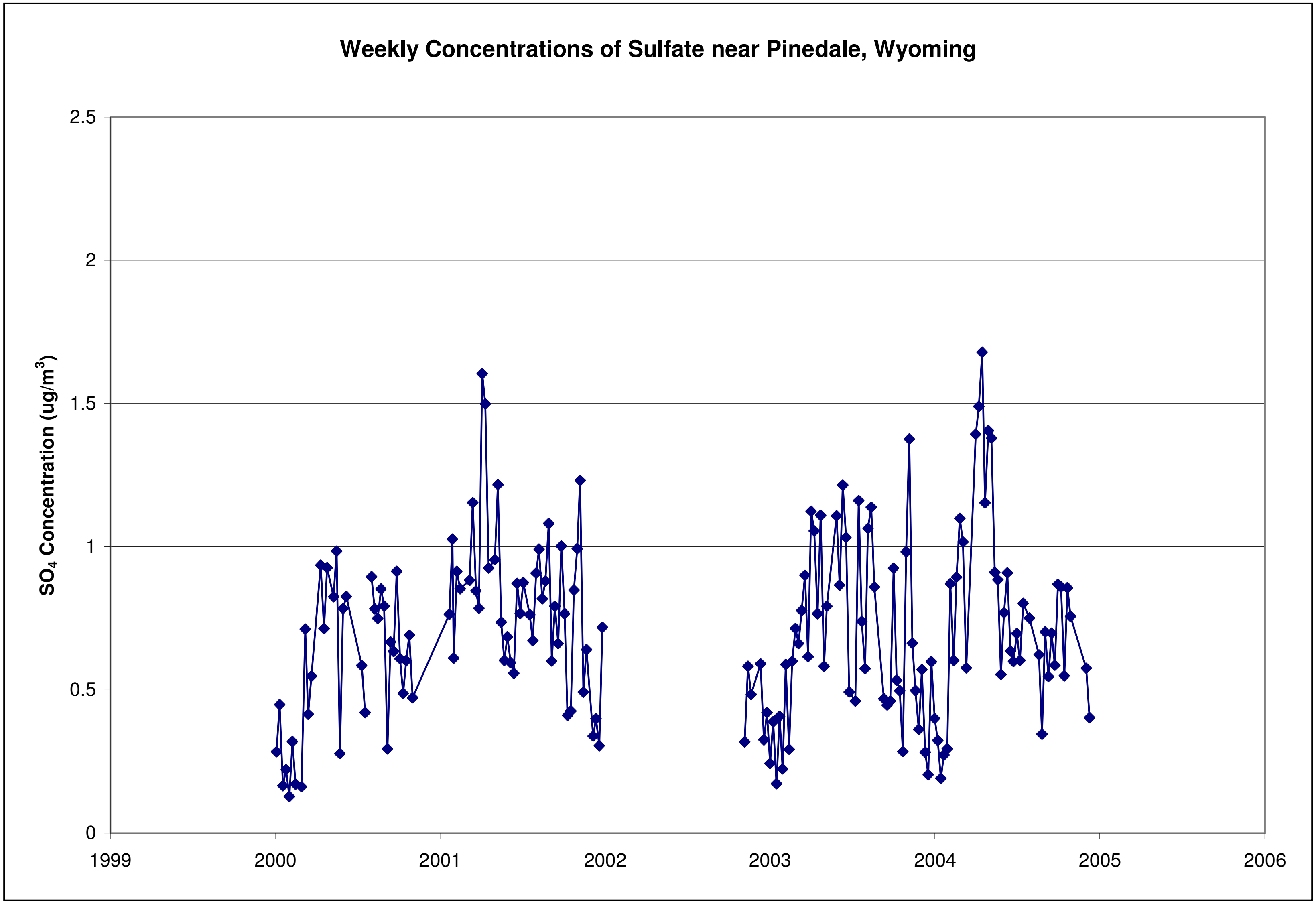
Source: BLM (Data from WARMS, Pinedale)

Figure 3.8. Weekly Concentrations of Ammonium near Pinedale, Wyoming (WARMS, Pinedale).



Source: BLM (Data from WARMS, Pinedale)

Figure 3.9. Weekly Concentrations of Sulfur Dioxide near Pinedale, Wyoming (WARMS, Pinedale).



Source: BLM (Data from WARMS,

Figure 3.10. Weekly Concentrations of Sulfate near Pinedale, Wyoming (WARMS, Pinedale).

Site-specific lake chemistry background data (pH, acid-neutralizing capacity [ANC], elemental concentrations, etc.) have been collected by the USFS in several high mountain lakes in the nearby Wilderness Areas. Lakes for which background data were collected are shown on Map 3.1. Lake acidification is measured in terms of change in ANC, which is the lake's buffering capacity to resist acidification from atmospheric deposition of acid compounds such as sulfates and nitrates. Measured baseline ANC data for sensitive lakes within the cumulative study domain are provided in Table 3.8.

Table 3.8. Monitored Background Conditions at Sensitive Lakes[1]

Sensitive Lake	Lake Location	Background ANC (μeq/l)[2]	Number of Samples	Period of Monitoring
Black Joe Lake	Bridger Wilderness Area	67.0	61	1984–2003
Deep Lake	Popo Agie Wilderness Area	59.9	58	1984–2003
Hobbs Lake	Bridger Wilderness Area	69.9	65	1984–2003
Lazy Boy Lake	Bridger Wilderness Area	18.8	1	1997
Upper Frozen Lake	Bridger Wilderness Area	5.0	6	1997–2003
Ross Lake	Fitzpatrick Wilderness Area	53.5	44	1988–2003
Lower Saddlebag Lake	Popo Agie Wilderness Area	55.5	43	1989–2003

[1] From USFS (2003).
[2] 10th Percentile Lowest ANC Values reported.

Lakes with ANC values ranging from 25 to 100 microequivalents per liter (μeq/l) are considered to be sensitive to atmospheric deposition, lakes with ANC values ranging from 10 to 25 μeq/l are considered very sensitive, and lakes with ANC values less than 10 μeq/l are considered extremely sensitive (Svalberg pers. comm.).

The USFS has identified specific AQRV "Level of Acceptable Change" (LAC) values, which are used to evaluate potential air quality impacts from deposition within their wilderness areas (USFS 2000). The USFS has identified a LAC of no greater than 1 μeq/l change in ANC (from human causes) for lakes with existing ANC levels less than 25 μeq/l. A limit of 10 percent change in ANC reduction was adopted for lakes with existing ANC greater than 25 μeq/l.

3.1.3 Topography

The JIDPA is located in the northern portion of the Green River Basin. Topography is generally gently rolling, with elevations ranging from approximately 7,400 feet on top of area buttes to about 7,000 feet on the JIDPA's southern boundary (Map 3.2). Topographic relief areas (butte slopes) typically range in height from 50 to 150 feet. Sand Draw, the major drainage in the JIDPA, bisects the area, flowing northeast to southwest into Alkali Creek (a tributary to the Green River). All drainages in the JIDPA are ephemeral, flowing only in response to snowmelt and rain events. Drainage is predominantly to the southwest in Sand Draw and to Alkali Creek, to the west into Granite Draw, and to the southeast into Jonah Gulch (to a closed basin) and Long Draw and Bull Draw (to the Big Sandy River). The CIAA for topography is the project-affected JIDPA watershed areas described in detail in Sections 3.1.5 (Soils) and 3.2.1 (Vegetation).

3.1.4 Geology

The JIDPA is located on the northeastern flank of the northern Green River Basin—a structural and topographical basin located between the Overthrust Belt to the west and the Wind River

Mountains to the east. The Pinedale Anticline, a large structural feature, is located immediately north and east of the JIDPA. Surface geology in the JIDPA is composed primarily of residuum mixed with alluvium, aeolian (windblown) material, slopewash, grus, and/or bedrock outcrops. Also present are areas of slopewash and colluvium mixed with scattered deposits of residuum, grus, glacial and periglacial alluvium, aeolian deposits, and/or bedrock outcrops; shallow alluvium mixed with scattered bedrock outcrops; and an area with stabilized sand dunes (Wyoming Geographic Information Science Center [WyGISC] 2003a) (Map 3.3).

Bedrock geology in the JIDPA is dominated by the Laney Member of the Green River Formation (Tgl) and the New Fork Tongue of the Wasatch Formation (Twg) (WyGISC 2003a) (Map 3.4). An area of the Wilkins Peak Member of the Green River Formation (Tgw) occurs in the west-central portion of the area. The Laney Member is composed of oil shale and marlstone; the New Fork Tongue consists of mudstone, sandstone, and thin limestone beds; and the Wilkins Peak Member is composed of tuffaceous sandstone.

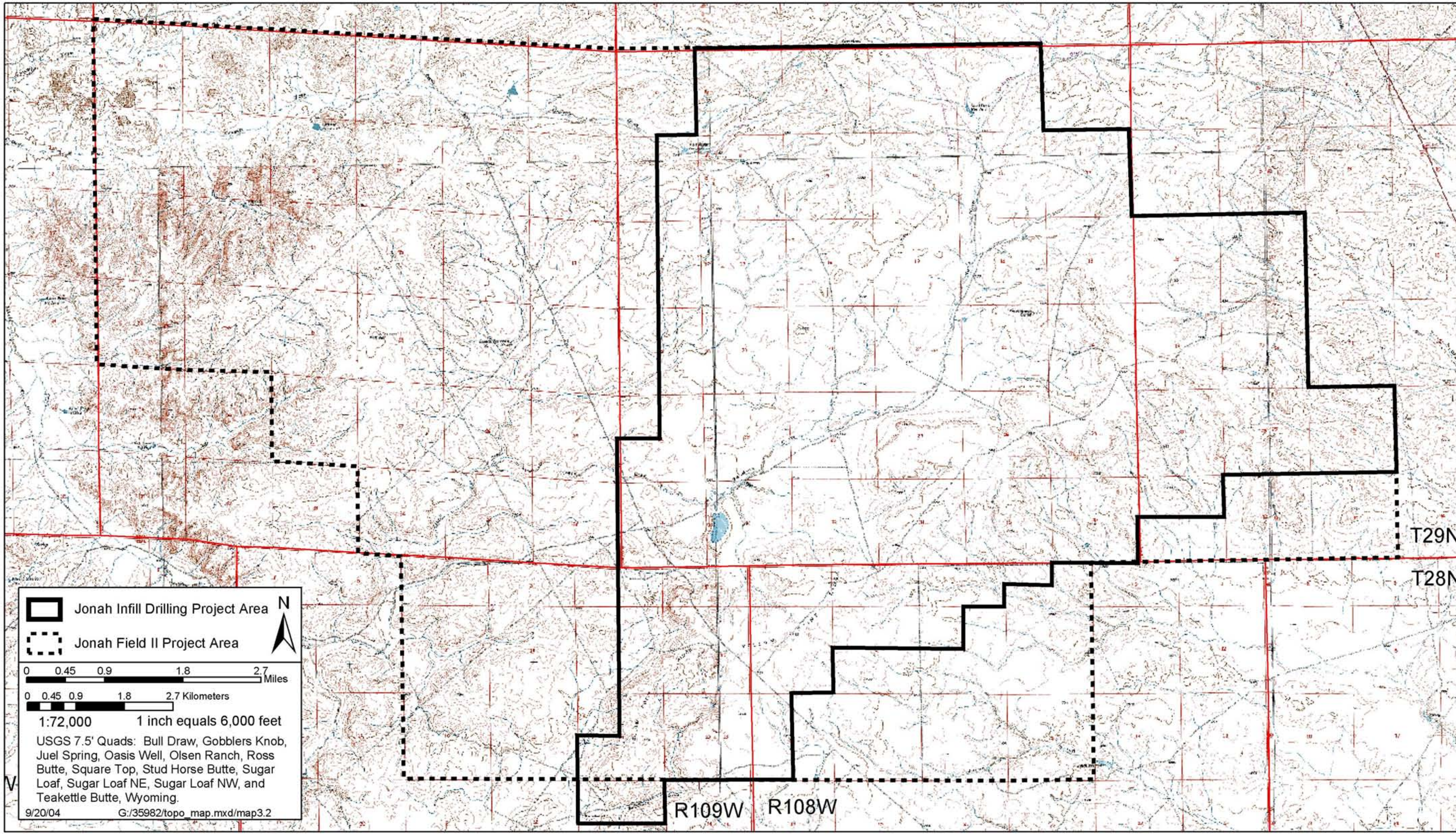
The JIDPA is underlain, in descending order, by the Tertiary Green River, Wasatch, and Fort Union Formations and an unnamed Tertiary bed; the Upper Cretaceous Lance Formation, Mesaverde Group (i.e., Almond Formation, Ericson Sandstone, Rock Springs Formation, and Blair Formation), and the Frontier Formation; the Lower Cretaceous Mowry Shale, Muddy Sandstone, Thermopolis Shale, and Cloverly Formation; and Jurassic, Triassic, Permian, Pennsylvanian, Mississippian (Madison Formation), Devonian, Ordovician, Cambrian, and Precambrian rocks (Figure 3.11). The Lance Pool, comprising the Lance Formation and the upper portions of the Mesaverde Group, is the primary target for gas production for the project.

Other than the Green River and Wasatch Formations, which occur at the surface, the geological formations underlying the JIDPA would not be adversely affected by the proposed Project and, therefore, are not discussed further in this EIS. Surface geology is considered under Topography (see Section 3.1.3).

3.1.4.1 Mineral Resources

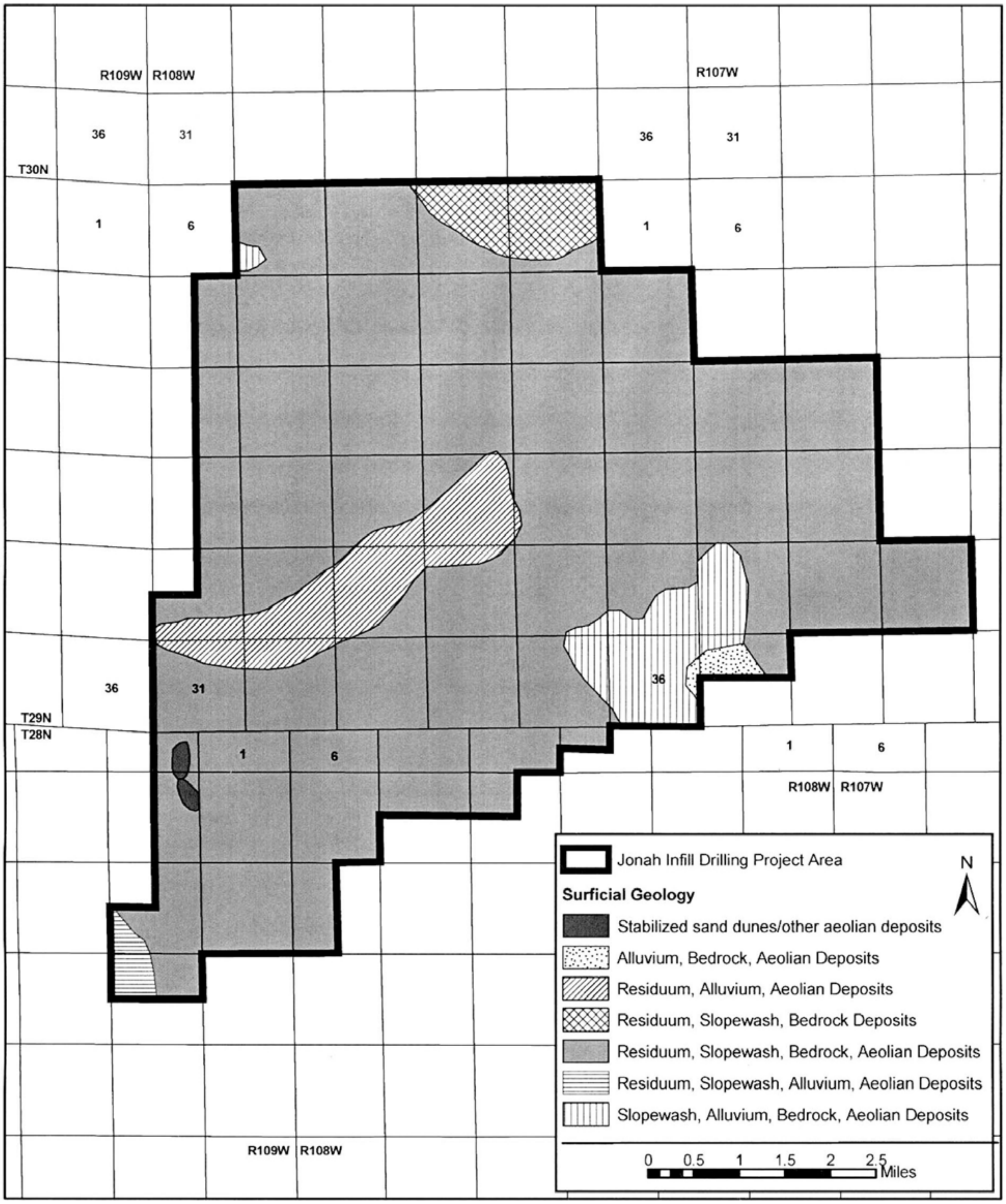
The mineral resources CIAA covers approximately 66,400 acres (103.8 square miles) on and surrounding the JIDPA and is defined as the combined Jonah EA, Jonah Field II EIS, and JIDPA areas (Map 3.5). Mineral resources within this area are generally as described below for the JIDPA; however, recovery of the natural gas resources in the CIAA area outside the JIDPA is currently considered uneconomic. Additional information on minerals industry earnings, labor, and revenues is provided in Section 3.4.

The Jonah Field is a highly productive sweet natural gas field that produces both natural gas and condensate (oil contained in the natural gas stream). The estimated volume of natural gas in place in the JIDPA is 12,800 billion cubic feet (BCF), with recoverable volumes estimated to range between 3,400 and 8,200 BCF; 1 BCF of natural gas is the average annual amount used by 13,700 Wyoming households (2002 use rates) (Energy Information Administration 2004). Through August 2004, approximately 1,121 BCF of gas and 11 million barrels of oil (MBO) had been produced from the field from over 500 wells (WOGCC 2004). Currently, the Jonah Field produces almost 250 BCF of natural gas a year, or 13.5% of all the natural gas produced in Wyoming. In terms of the quantity of gas produced in Wyoming, the Jonah Field is second only to the Powder River Basin, which encompasses several million acres in Campbell, Sheridan, and Johnson Counties in northeast Wyoming.



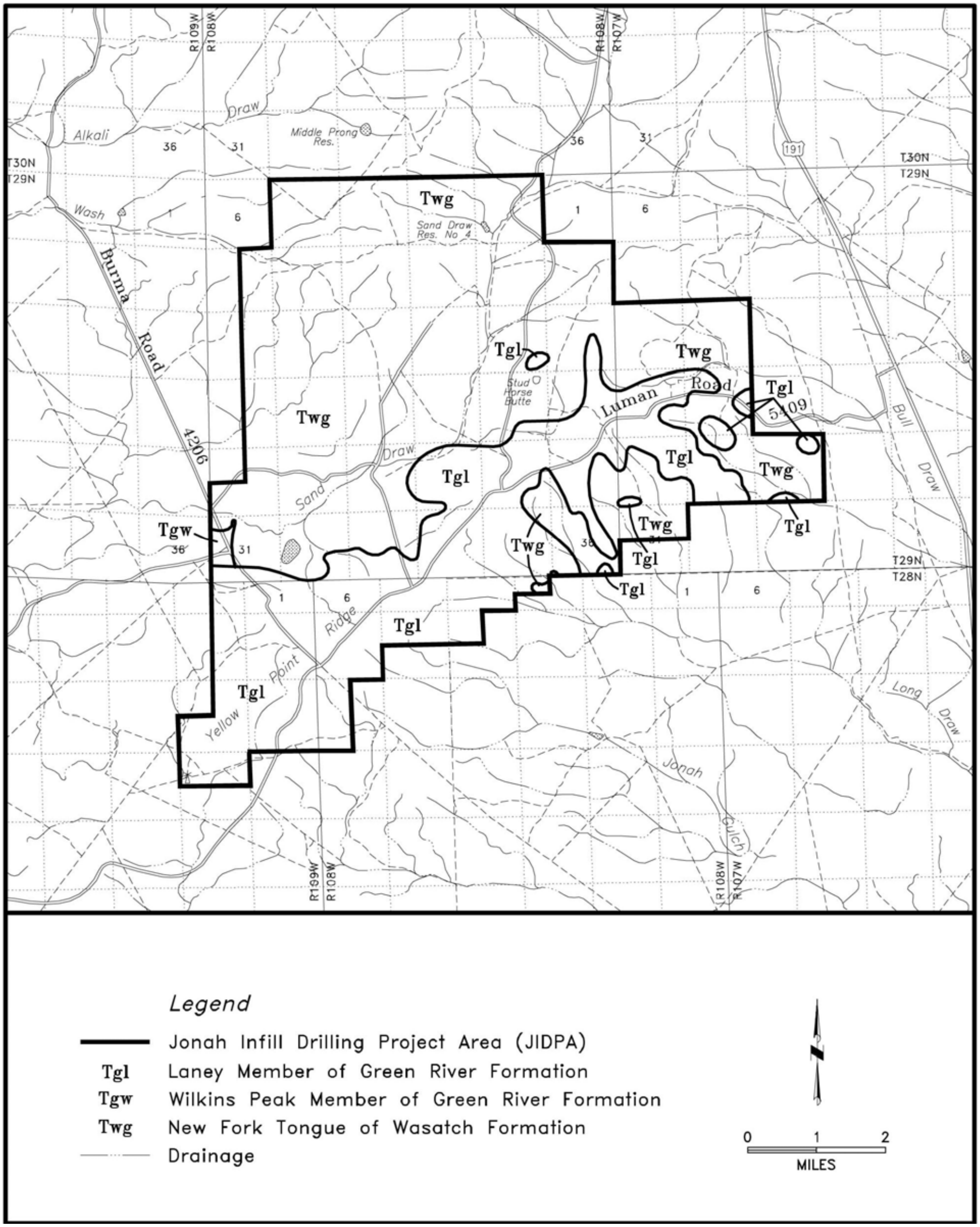
Source: BLM

Map 3.2. Area Topography, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006.



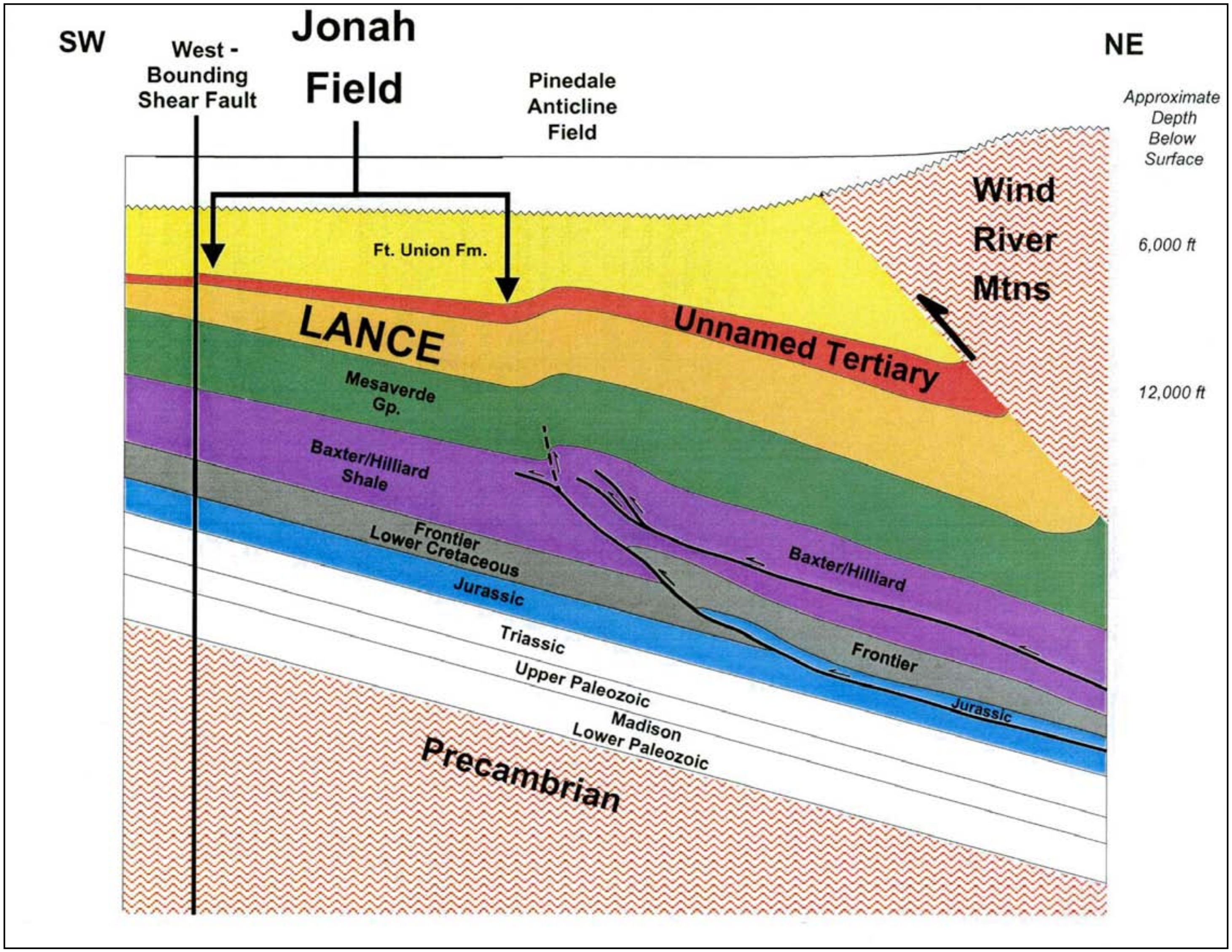
Source: BLM (Based on data from the Wyoming Geographic Information Science Center, 2003)

Map 3.3. Surface Geology, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006.



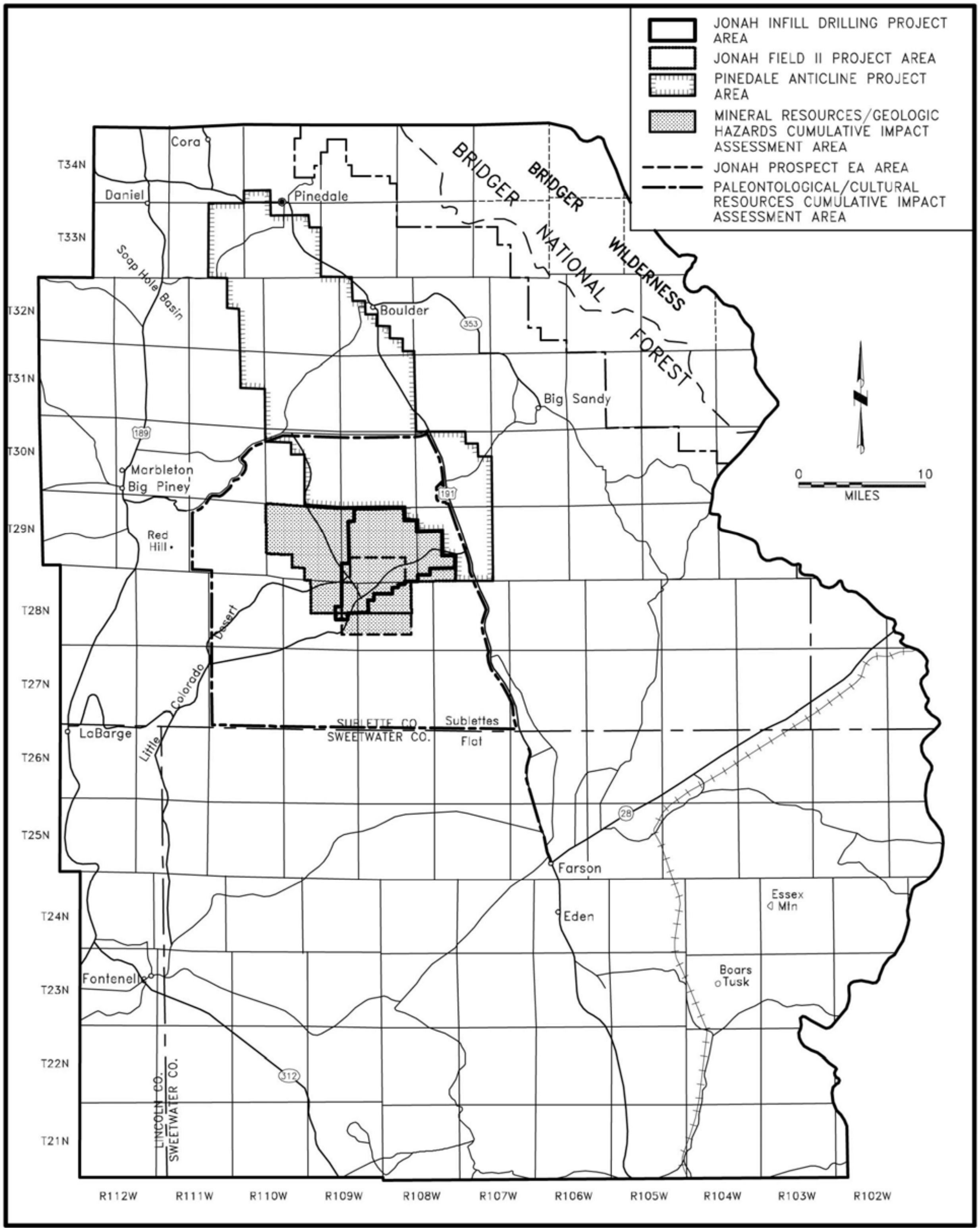
Source: BLM (Based on data from the Wyoming Geographic Information Science Center, 2003)

Map 3.4. Bedrock Geology, Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006.



Source: EnCana

Figure 3.11. Formations Underlying the Jonah Infill Drilling Project Area, Sublette Country, Wyoming, 2006.



Source: BLM

Map 3.5. Mineral Resources/Geologic Hazards and Paleontological/Cultural Resources Cumulative Impact Assessment Areas, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

Among gas fields in southwestern Wyoming, the estimated 12,800 BCF original gas in place (OGIP) for the JIDPA (30,500 acres) is more than four times that of the 2,933 BCF OGIP within the vastly larger (81,920-acre) Bruff Field in Sweetwater County. In an acre-by-acre comparison, the JIDPA contains approximately 0.42 BCF per acre compared to 0.036 BCF per acre in the Bruff Field, 0.022 BCF per acre in the Fontenelle Field, and 0.011 BCF per acre in the Wamsutter-Continental Divide Natural Gas Field. Thus, per acre, the Jonah Field contains several times more OGIP and gas reserves than other fields in southwestern Wyoming, and the oil reserves (from condensate) are also significantly higher than other fields in southwestern Wyoming.

The Lance Formation (from which natural gas would be obtained) is a sedimentary formation, formed by fluvial processes, whereby sediments were deposited in complex, discontinuous bodies by braided flowing streams. Figure 3.12 provides a photograph of a typical braided stream. The gas-bearing sediments of the Lance Formation occur in numerous discontinuous lenses (see Appendix B, Figure 2.2).

Other mineral resources in the area include coal and sand and gravel. The JIDPA is located within the Green River Basin Coal Field (Jones 1991) and is underlain by coal-bearing rocks. However, the potential for coal development is low because coal beds are thin and too deep to be economically mined. Limited sand and gravel resources occur in the JIDPA, and these resources have been used for existing area developments (e.g., roads). No other minerals are known to occur in the JIDPA (Harris 1996, 1997; Hausel 1997).

3.1.4.2 Geologic Hazards

The geologic hazards CIAA covers the same 66,400 acres (103.8 square miles) as the mineral resources CIAA (see Map 3.5). Geologic hazards within the CIAA are generally as described below for the JIDPA.

All of Wyoming is seismically active, and the western quarter of the state is more active than the eastern three-quarters (Case 1997). The JIDPA is within an area where an earthquake could have an estimated peak acceleration of 16–20% gravity and an estimated 2,500-year recurrence interval. Earthquakes with acceleration of 16–20% gravity are equivalent to earthquakes with intensities of VII to VIII on the modified Mercali scale, which cause negligible to slight damage in well-designed buildings, slight to considerable damage in ordinary structures, and considerable to great damage in poorly built structures. In the western quarter of Wyoming, an intensity V earthquake (less intense than VII; windows broken, plaster cracked, objects overturned) can be expected to occur about every 1.5 years (Case 1997).

Numerous earthquakes have occurred in a north/south-trending belt between Big Piney and Evanston in recent years. An earthquake with a 3.3 magnitude (Richter scale) occurred within the area in 1978 (Case et al. 1995). The epicenter was located in the northern portion of T29N, R108W. The Continental Fault System and the Leckie Fault occur approximately 10 miles northeast of the JIDPA (Case 1997). It is not known whether these faults have been active in Quaternary times.

No landslides or active sand dunes are known to occur in the JIDPA (WyGISC 2003a), nor are there any known areas of subsidence (Case pers. comm.).

Source: EnCana

Figure 3.12. Typical Braided Stream.

3.1.4.3 Paleontological Resources

The CIAA for paleontological resources covers approximately 484.4 square miles (310,000 acres) on and surrounding the JIDPA (see Map 3.5). Approximately 3,331 acres of the CIAA have been disturbed primarily from existing oil and gas developments and associated road and pipeline networks. Forty-two percent of this disturbance (1,409 acres) occurs within the JIDPA, 1,388 acres are due to roads outside the JIDPA, 468 acres are due to well pads outside the JIDPA, and 66 acres are due to agricultural lands. Paleontological resources within the CIAA are generally the same as described for the JIDPA, and 26 fossil localities are known from the CIAA (Erathem-Vanir Geological Consultants 1997). Vertebrate fossils, including mammalian species, are known from some of these localities. The localities occur on the Green River, Wasatch, and Bridger Formations.

The important fossil record of the Green River Basin is well known (BLM 1992, Grande 1984). Table 3.9 provides information on the various geologic formations present on and in the vicinity of the JIDPA and their paleontological potential.

Table 3.9. Surface Geologic Formations Present on the Jonah Infill Drilling Project Area and Their Paleontological Potential, Sublette County, Wyoming, 2006[1]

Deposit[2]	Geologic Age	Type of Deposit/ Environment of Deposition	Thickness	Fossil Resources	Fossil Potential
Alluvial sediments	Holocene	Unconsolidated silts, sands of valleys and plains; terrestrial	<20 feet	None	Low
Terrace deposits	Pleistocene/ Holocene	Gravels, silts, and sands that predate current erosional cycle; terrestrial-fluvial	<40 feet	Pleistocene mammals	Moderate
Green River Fm Laney Mbr LaClede Bed	Middle Eocene	Chiefly oil shale, lesser algal limestone, sandstone, claystone, and tuff; lacustrine, accumulated during renewed expansion of Lake Gosiute	<100 feet	Vertebrates, invertebrates, trace fossils	High
Green River Fm Wilkins Peak Mbr (upper part)	Early-Middle Eocene	Chiefly brown or black oil shale interbedded with gray or green mudstone, evaporitic; lacustrine, deposited during re-expansion of Lake Gosiute (upper)	<150 feet	Vertebrates, invertebrates, plants	High
Wasatch Fm Alkali Creek or New Fork Tongue	Early Eocene	Interbedded brown, green, and gray sandstone, siltstone, mudstone, and shale, locally conglomeratic; chiefly terrestrial-fluvial to floodplain, some lacustrine	<100 feet	Vertebrates, invertebrates, plants	High

[1] Adapted from Erathem-Vanir Geological Consultants (1997).
[2] Fm = formation; Mbr = member.

The Green River and Wasatch Formations contain fossils from each of the five biological kingdoms and are well known for their abundant fish fossils (Grande 1984). The Laney Member of the Green River Formation is especially fossiliferous. Terrestrial mammalian fossils are not common because the Green River Formation was formed predominantly from lake deposits; however, reptile (crocodile, alligator, snake, lizard), amphibian (frog, salamander), bird (pelican, grouse, shorebird, and small perching bird), and insect and other invertebrate fossils have been recorded. Although uncommon, mammalian fossils, including marsupials, insectivores, primates, rodents, carnivores, and ungulates have been recovered.

The fossil flora of the Laney Member is not well studied but includes sycamore, horsetail, and lily pads. Other members of the Green River Formation, however, include a diverse mixture of trees, shrubs, and flowers, suggesting that the fossil flora of the Laney Member may be more diverse than is now known. Insects and other invertebrates (gastropods, arthropods), algae, fungi, flagellates, and bacteria also have been recovered from the Green River Formation. A review of museum and university records and literature (Erathem-Vanir Geological Consultants 1997) indicated no known significant localities within the JIDPA, although two localities occur within 1.0 mile of the area. However, during past JIDPA developments, a few fossils of a Pleistocene horse (tentative identification) were discovered in JIDPA terrace deposits during construction of a well pad. It is likely that important fossils, including both Eocene and Pleistocene materials, are located in the JIDPA.

3.1.5 Soils

The CIAA for soil resources is the combined area of the 10 watersheds that drain the JIDPA (see Section 3.1.6). This CIAA covers approximately 328.6 square miles (210,300 acres) (Table 3.10, Map 3.6). Estimates of the types of soils most likely to be disturbed are based on coarse-scale Wyoming Gap Analysis soil information (Munn and Arneson 1999a, 1999b). Extant soils information for the CIAA (coarsely mapped) indicates that soil map units SU03 and SU05 are the predominant soil types in the area (see Table 3.10). Approximately 1.6% (3,354.7 acres) of the CIAA has been disturbed primarily by oil and gas developments and roads (Table 3.11) and approximately 42% (1,409 acres) of this disturbance exists as long-term disturbance in the JIDPA; no crop lands or residential areas are known to occur within the CIAA. The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance (991.5 acres, or 4.2% of the watershed), and most of this disturbance (664.9 acres) is from existing natural gas developments in the JIDPA (see Table 3.11).

Seventeen soil mapping units (fine resolution mapping) occur within the JIDPA (Map 3.7 and Table 3.12) (ERO Resources Corporation 1988; Munn and Arneson 1999a, 1999b; BKS Environmental Associates, Inc. 2003; Natural Resources Conservation Service [NRCS] 2003). Table 3.12 lists the fine-scale soil map units, their JIDPA acreage, and soil use limitations and management considerations. Many of the soils within the JIDPA have characteristics that limit their suitability for road construction and may inhibit successful reclamation. The primary factors limiting soils use for road construction are shallow depth to rock, low strength, shrink-swell potential, frost action, flooding, and steep slopes. Reclamation potential is limited by alkalinity and salinity; excess stones, sand, clay, and/or lime; shallow depths; and steep slopes.

One known area of stabilized sand dunes and other aeolian (windblown) deposits occur in the JIDPA (see Map 3.3) (Case and Boyd 1987), and it is likely that smaller areas of sand dunes or windblown deposits also occur in the area. The Spool Variant-Ouard Variant-San Arcacio Variant soil series (map unit 123) and Garsid-Terada-Langspring Variant complex (map unit 121) contain these features (see Table 3.12 and Maps 3.3 and 3.6). Stabilized dunes and other windblown deposits are usually very sandy and are highly susceptible to wind erosion. However, these soil types and/or known stabilized dunes are not common within the JIDPA and, where they do occur, they are limited in size and areal extent.

Major soils within the JIDPA include the Vermillion Variant-Seedskadee-Fraddle complex on 0–3% slopes (map unit 127); the Monte-Leckman complex on 1–6% slopes (map unit 106); the Fraddle-Ouard-San Arcacio Variant complex on 3–8% slopes (map unit 124); the Ouard-Ouard Variant-Boltus complex on 1–8% slopes (map unit 114); the Garsid-Monte Association on 1–6% slopes (map unit 119); the San Arcacio-Saguache association on 0–3% slopes (map unit 125); the

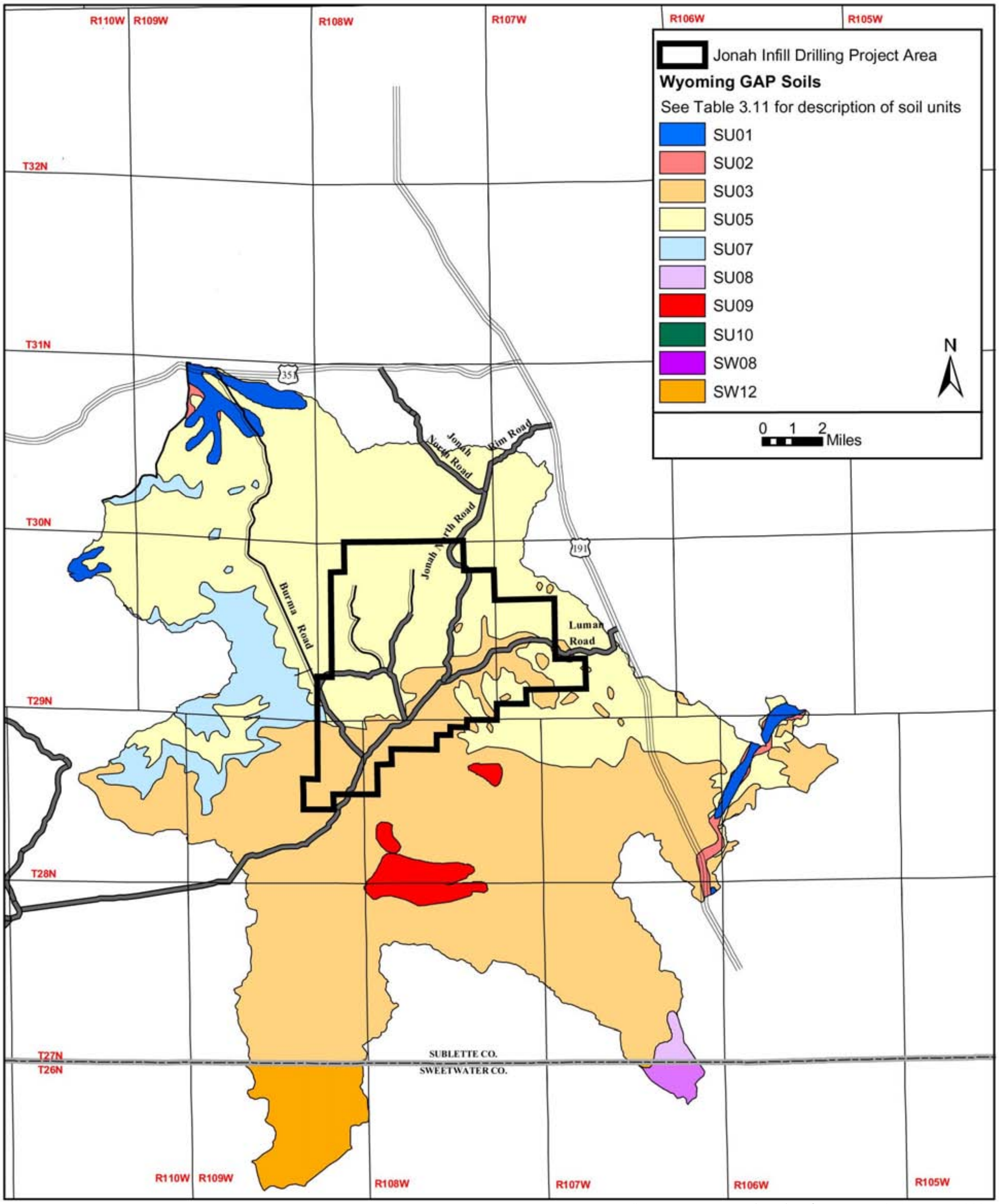
Huguston-Horsley-Terada complex on 6–30% slopes (map unit 116); and the Haterton-Garsid complex on 1–8% slopes (map unit 113) (see Table 3.12). These mapping units collectively cover approximately 78% of the JIDPA. The Cowestglen sand loam on 0–2% slopes (map unit 951/106) and the Monte-Leckman complex (map unit 106) on 1–6% slopes occur adjacent to drainage channels and on terraces and alluvial fans.

Table 3.10. Soil Types in the Soil Resources Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Soil Map Unit[1]	Soil Type Description[1]	Total Acres	% of CIAA	Acres in JIDPA
SU01	Typic Torrifluvents, fine-silty and fine, mixed (calcareous), frigid-Typic Haplaquepts, fine-loamy and fine loamy over sandy or sandy-skeletal, mixed (calcareous), frigid	4,495	2.1	0
SU02	Aquic Haplustolls, coarse-loamy, mixed, frigid-Ustic Torriorthents, fine-loamy, mixed (calcareous), frigid-Typic Fluvaquents, fine-loamy, mixed (calcareous) frigid	899	0.4	0
SU03	Rock Outcrop-Typic Torriorthents, loamy, mixed (calcareous) frigid, shallow-Lithic Typic Torriorthents, loamy-skeletal, mixed (calcareous), frigid-Typic Natrargids, fine-loamy, mixed, frigid	93,700	44.6	9,913
SU05	Typic Torriorthents, loamy, mixed (calcareous) frigid, shallow-Typic Haplocalcids, coarse-loamy, mixed, frigid-Lithic Torriorthents, loamy-skeletal, mixed (calcareous), frigid	68,323	32.5	20,496
SU07	Ustic Torriorthents, fine loamy, mixed (calcareous), frigid-Ustic Torriorthents loamy, mixed (calcareous), frigid, shallow-Typic Haplocalcids, fine-loamy, mixed, frigid	20,229	9.6	91
SU08	Typic Haplosalids, fine, mixed, frigid-Typic Haplocambids, fine-silty, mixed, frigid	10,249	4.9	0
SU09	Typic and Lithic Torripsamments, mixed, frigid-Typic Torriorthents, loamy-skeletal, mixed, frigid-Rock Outcrop-Typic Haplocambids, loamy-skeletal, mixed, frigid	3,596	1.7	0
SW08	Typic Haplosalids, fine, mixed, frigid and Typic Haplocambids, fine-silty, mixed, frigid	1,079	0.5	0
SW12	Ustic Haplargids, fine-loamy and coarse-loamy, mixed, frigid-Ustic Haplocambids, sandy, mixed, frigid	7,730	3.7	0
Total		210,300	100.0	30,500

[1] Based on Munn and Arneson (1999a, 1999b).

Several soils (i.e., Monte-Leckman [map unit 106], Fraddle-Tresano [map unit 110], Garsid-Monte [map unit 119], and Baston-Boltus-Chrisman [map unit 122] complexes/associations) may be good sources for topsoil (ERO Resources Corporation 1988) (see also Appendix B). The Spool Variant-Ouard Variant-San Arcacio Variant (map unit 123), the Fraddle-Ouard-San Arcacio Variant (map unit 124), and the San Arcacio-Saguache (map unit 125) complexes/associations may be good gravel sources. The San Arcacio soils are also considered to be archaeologically sensitive in that they contain intact buried cultural resources. The Chrisman silty clay soil (map unit 104) is typically fine-textured and formed in thick clayey local alluvium in closed basins and is susceptible to high shrink-swell potential that may limit road construction activities (ERO Resources Corporation 1988).



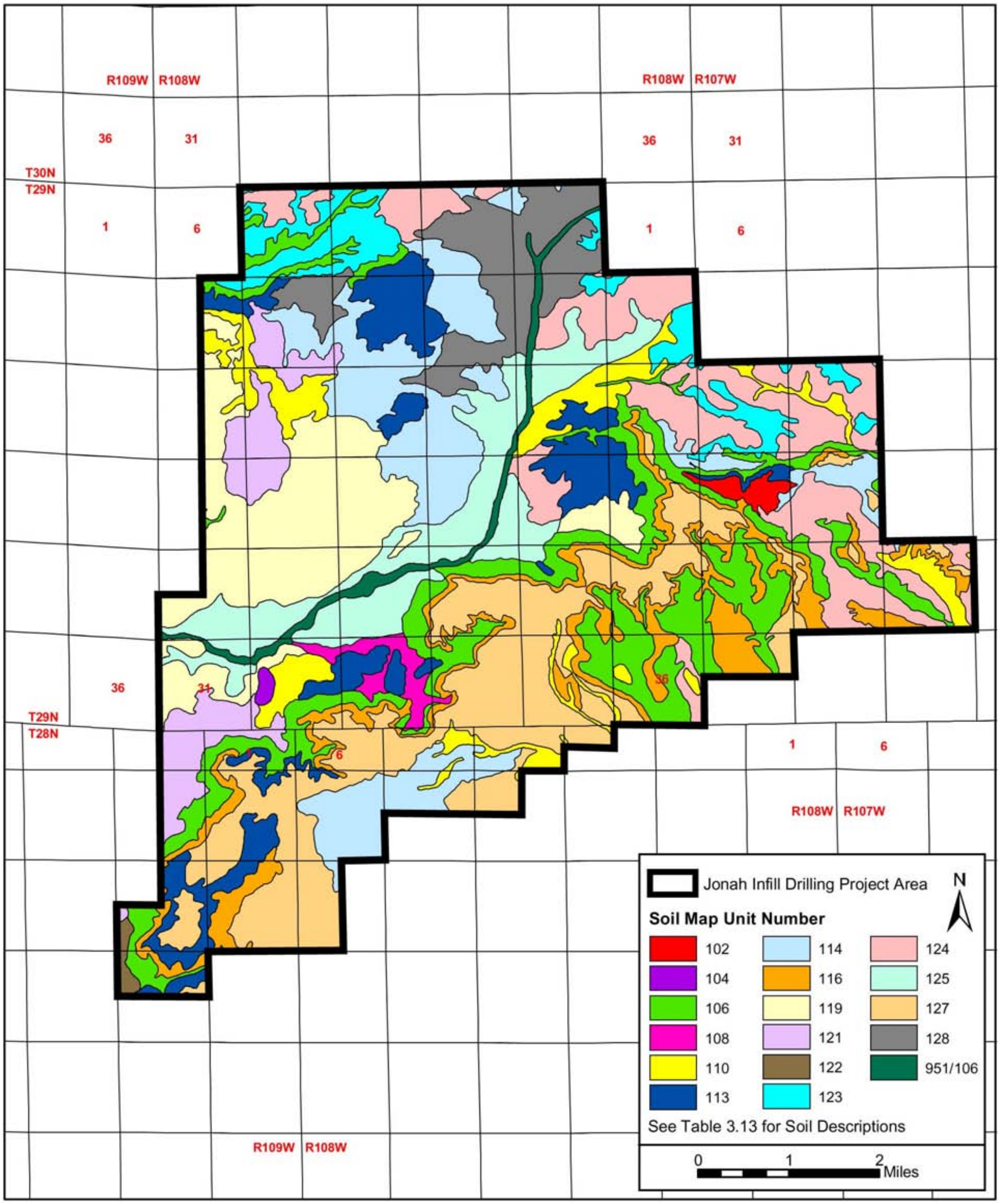
Source: BLM (Based on data from Munn & Arneson, 1999)

Map 3.6. Soil Types (coarse-scale) within the Soils Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Wyoming, 2006.

Table 3.11. Existing Watershed Disturbance Acreage, Jonah Infill Drilling Project, Cumulative Impact Assessment Area, Sublette County, Wyoming, 2006

Type	Watersheds										Total
	Expanded Sand Draw-Alkali Creek	Granite Wash	Reduced Upper Alkali Creek-Green River	Upper Eighteenmile Canyon	Southeast New Fork River-Blue Ridge	North Alkali Draw	Big Sandy River-Bull Draw	Long Draw	Jonah Gulch	140401-040603	
Watershed Acreage	23,373	12,212	26,355	35,212	11,746	15,911	19,760	18,521	22,652	24,558	210,300
Disturbance in the JIDPA[2]	664.9	0.0	114.1	132.6	0.0	0.0	43.7	390.3	24.0	39.4	1,409.0
Disturbance Outside the JIDPA											
Wells [3]	4.0	0.0	8.0	56.0	0.0	12.0	0.0	8.0	12.0	12.0	112.0
Roads[4]											
Connecting road	0.0	1.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	4.4
Jeep trail	6.5	0.0	8.3	9.1	0.0	0.8	0.0	0.0	24.7	24.6	74.0
Neighbor-hood road	146.2	34.6	141.7	170.2	19.8	85.0	128.5	88.0	84.6	84.8	986.4
State highway	0.0	0.0	0.0	0.0	0.0	0.0	58.2	83.6	0.0	0.0	141.8
Other (new oil and gas roads)	169.9	0.4	80.6	241.8	0.0	0.0	30.2	101.6	5.6	0.0	630.1
Subtotal	322.6	36.0	230.6	421.1	23.2	85.8	216.9	273.2	114.9	109.4	1,833.7
Total Disturbance	991.5	36.0	352.7	609.7	23.2	97.8	260.6	671.5	150.9	160.8	3,354.7
% of Watershed Disturbed	4.2	0.3	1.3	1.7	0.2	0.6	1.3	3.6	0.7		

[1] Data gathered from WyGISC (2003b), WOGCC (2003), TRC Mariah (2004a, 2004b), and unpublished BLM aerial photography.
[2] See Table 2.3.
[3] Assumes 4 acres per well pad.
[4] Road acreage based on 20-foot width for connecting roads, jeep trails, and neighborhood roads; 29-foot width for other roads; and 150-foot width for state highways.



Source: BLM (Based on data from ERO Resources (1988) & BKS Environmental (2003))

Map 3.7. Soils Types (Fine-Scale) within the Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

Table 3.12. Soil Types[1], Soil Use, and Management Considerations for Soils, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Map Unit No.	Map Unit Name	Use and Management Considerations	Acres
102	Langspring Variant-Langspring complex, 1–10% slopes	Gently sloping to nearly level mesa tops and uplands. Loamy uplands. Generally suitable for road construction. Rehabilitation limited due to excess lime and small stones.	149
104	Chrisman silty clay, 0–2% slopes	Saline upland sites, in closed basins. Construction activities limited due to severe shrink-swell properties. Rehabilitation potential limited by moderately alkaline soils.	42
106	Monte-Leckman complex, 1–6% slopes	Gently sloping alluvial fans and drainageways. Loamy, saline uplands. Mostly suitable for road construction. Rehabilitation limited by excess sands or small stones.	3,488
108	Dines-Clowers-Quealman complex, 0–3% slopes	Nearly level to gently sloping drainageways and alluvial terraces. Loamy sites, saline uplands. Limited for road construction due to low strength. Rehabilitation potential limited by excess salt, sand, and small stones.	268
110	Fraddle-Tresano complex, 1–8% slopes	Rolling uplands, upper dissected fans, and valley-filling slopes. Loamy uplands. Limited for construction activities and reclamation due to thin soils.	1,541
113	Haterton-Garsid complex, 1–8% slopes	Nearly level to gently sloping uplands and sideslopes. Shallow loamy and loamy sites. Construction limited by shallow depth to bedrock, slope, and low strength. Rehabilitation limited by shallow depth to bedrock and steep slopes.	2,102
114	Ouard-Ouard Variant-Boltus complex, 1–8% slopes	Nearly level to gently sloping uplands. Shallow loamy, shallow clayey, and shaley sites. Limited due to low strength and shallow depth to bedrock. Rehabilitation limited due to thin soils.	3,132
116	Huguston-Horsley-Terada complex, 6–30% slopes	Gently sloping to moderately steep sideslopes and rolling uplands. Shaley and loamy sites. Limited due to shallow depth to bedrock, low strength, and steep slopes. Rehabilitation limited by shallow depths and slopes.	2,109
119	Garsid-Monte association, 1–6% slopes	Gently undulating uplands. Loamy sites. Construction limited by thin soils, low strength, and steep slopes. Rehabilitation limited by steep slopes.	3,087
121	Garsid-Terada-Langspring Variant complex, 1–6% slopes	Undulating uplands. Loamy sites. Construction limited due to thin soils, low strength, and steep slopes. Rehabilitation limited by steep slopes, small stones, and excess lime.	1,261
122	Baston-Boltus-Chrisman association, 0–6% slopes	Undulating and dominantly concave uplands. Clayey, shaley, and saline upland sites. Construction limited by low strength, shrink-swell potential, thin soils, and steep slopes. Rehabilitation limited by thin soils, clayey textures, excess salt and steep slopes.	85
123	Spool Variant-Ouard Variant-San Arcacio Variant complex, 4–25% slopes	Gently sloping to steep sideslopes and rolling uplands. Shallow sandy, shallow clayey and loamy sites. Construction limited by shallow depth to bedrock and low strength. Rehabilitation limited by shallow depths, small stones, sandy or clayey textures, or steep slopes.	1,260
124	Fraddle-Ouard-San Arcacio Variant complex, 3–8% slopes	Rolling uplands. Loamy and shallow loamy sites. Construction limited by thin soils and low strength. Rehabilitation limited by thin soils, clayey textures, or small stones.	3,194
125	San Arcacio-Saguache association, 0–3% slopes	Old floodplains, fans, and terraces. Loamy and sandy sites. Generally suitable for road construction. Rehabilitation limited by small stones.	2,304
127	Vermillion Variant-Seedskadee-Fraddle complex, 0–3% slopes	Nearly level uplands and mesas. Shallow loamy and loamy sites. Limited for construction due to shallow depth to bedrock, low strength, and thin soils. Rehabilitation limited by stoniness, excess lime, and thin soils.	4,427
128	Fraddle-Ouard-San Arcacio Variant complex, 0–3% slopes	Nearly level upland surfaces. Loamy and shallow loamy sites. Construction limited by low strength and shallow depth to bedrock. Rehabilitation limited by thin soils and small stones.	1,645
951/106	Cowestglen sandy loam, 0–2% slopes/see also Map Unit 106, above	Nearly level drainage ways. Road construction potentially limited by moderate frost action and flooding. See also Map Unit 106, above.	406
Total			30,500

[1] Adapted from: ERO Resources Corporation (1988) and BKS Environmental Associates Inc. (2003).

The extent of erosion in the JIDPA is currently undefined. Erosion modeling was conducted to assess the relative impacts of the alternatives considered on soil loss (HydroGeo 2005; see Appendix E). The modeling looked at the sediment loss experienced during individual storms of varying size; the amount of erosion experienced is proportional to the size of the storm. Under existing conditions, the model estimates that sediment loss in the JIDPA ranges from 16,110 kilograms during a 5-year storm (a 5-year storm has a 20% chance of occurring in any given year), and over 1.3 million kilograms during a 150-year storm (a 150-year storm has less than a 1% chance of occurring in any given year) (Table 3.13).

Table 3.13. Modeled Sediment Loss under Existing Conditions, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Major Drainage/Watershed	Percentage of JIDPA Area	Soil Loss (kg) during 5-year storm	Soil Loss (kg) during 150-year storm
Green River/New Fork River			
Expanded Sand Draw-Alkali Creek	45	0	320,822
Granite Wash	4.3	20	243,820
Reduced Upper Alkali Creek-Green River	12.4	6,150	1,052,956
Upper Eighteenmile Canyon	6.4	172	219,184
Southeast New Fork River-Blue Ridge	0	Not modeled	Not modeled
North Alkali Draw	0	Not modeled	Not modeled
Subtotal	68.1	6,342	1,836,782
Big Sandy River			
Big Sandy River-Bull Draw	11.9	1,444	1,638,147
Long Draw	16.5	7,123	4,730,072
Subtotal	28.4	8,567	6,368,219
Closed Basin			
Jonah Gulch	1	Not modeled	Not modeled
140401040603	2.5	1,203	170,173
Subtotal	3.5	1,203	170,173
Total	**100**	**16,112**	**8,375,174**

Source: HydroGeo (2005) ; see Appendix E.

The watersheds contributing to the Big Sandy River, Long Draw and Bull Draw, account for the most soil loss from the JIDPA: 53% during a 5-year storm, and 76% during a 150-year storm, despite the fact that these watersheds account for only 28% of the JIDPA. In contrast, Sand Draw, which represents the largest watershed within the JIDPA (45% of the total area), accounts for only 4% of the total sediment lost.

The Transportation and Reclamation Plans (Appendix B, subappendices DP-A and DP-B, respectively) contain further information on soil characteristics, suitability for road construction and reclamation, use and management considerations, and criteria for establishing soil suitability for various uses.

3.1.6 Water Resources

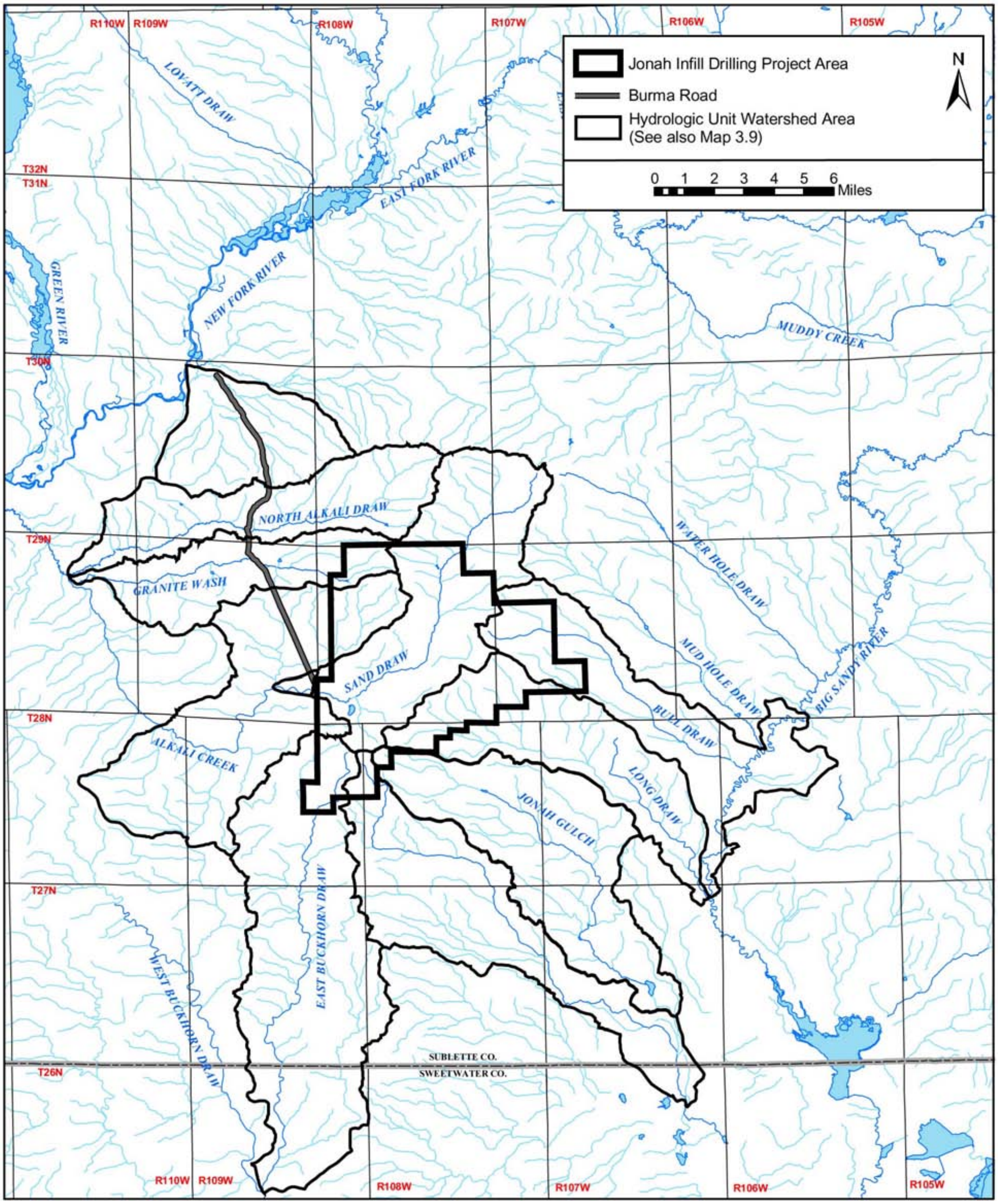
3.1.6.1 Surface Water

The CIAA for surface water resources is the combined area of the 10 watersheds that drain the JIDPA, which encompass approximately 328.6 miles (210,300 acres) (Table 3.14 and Maps 3.8 and 3.9). Approximately 1.6% (3,354.7 acres) of the CIAA has been disturbed, primarily by oil and gas developments and roads (see Table 3.11). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance—4.2% of the watershed (991.5 acres)—and most of this disturbance (664.9 acres) is from existing natural gas developments in the JIDPA (see Table 3.11).

The JIDPA lies within the Upper Green River Basin and is part of the Colorado River drainage system. The entire JIDPA is drained by intermittent and ephemeral streams; there are no perennial streams or springs in the area. However, there are two playas and several reservoirs and stockponds constructed in ephemeral washes that may contain water for all or a part of some years. The nearest flowing perennial water bodies to the JIDPA are the Big Sandy, New Fork, and Green Rivers (see Map 3.8).

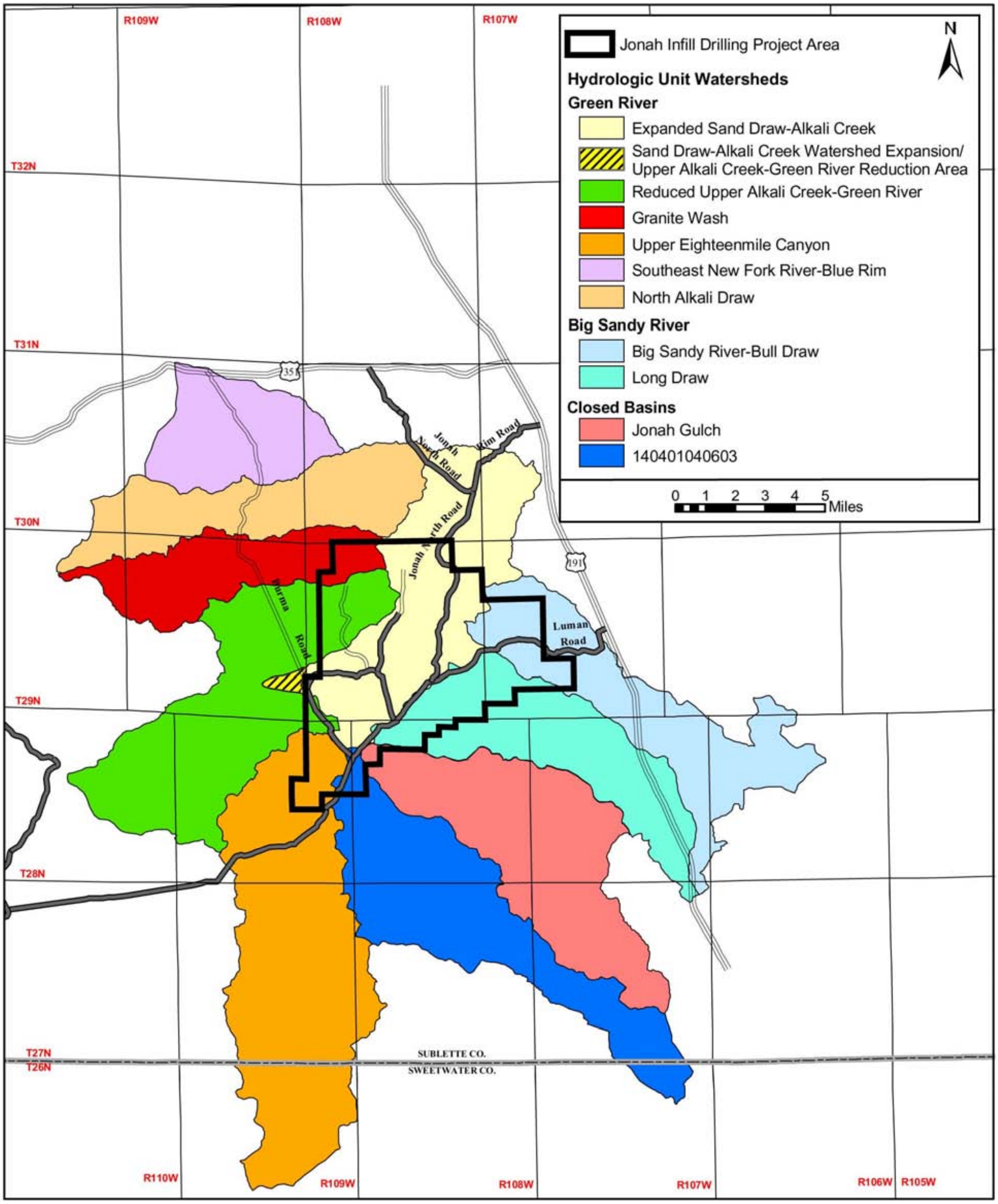
Table 3.14. Watershed Acreages, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Major Drainage/Watershed	Total Acreage of Watershed	Acres within JIDPA	Percent of JIDPA in Watershed	Percent of Watershed in JIDPA	Watershed Acreage Along Burma Road (Outside JIDPA)
Green River/New Fork River					
Expanded Sand Draw-Alkali Creek	23,373	13,724	45.0	58.7	2
Granite Wash	12,212	1,312	4.3	10.7	5
Reduced Upper Alkali Creek-Green River	26,355	3,782	12.4	14.4	9
Upper Eighteenmile Canyon	35,212	1,958	6.4	5.6	0
Southeast New Fork River-Blue Rim	11,746	–	–	–	13
North Alkali Draw	15,911	–	–	–	6
Subtotal	124,809	20,776	68.1	16.6	35
Big Sandy River					
Big Sandy River-Bull Draw	19,760	3,630	11.9	18.4	0
Long Draw	18,521	5,028	16.5	27.1	0
Subtotal	38,281	8,658	28.4	22.6	0
Closed Basin					
Jonah Gulch	22,652	318	1.0	1.4	0
140401040603	24,558	748	2.5	3.0	0
Subtotal	47,210	1,066	3.5	2.3	0
Total	**210,300**	**30,500**	**100.0**	**14.5**	**35**



Source: BLM

Map 3.8. Surface Water Resources in the Jonah Infill Drilling Project and Associated Cumulative Impact Assessment Areas (Project-affected Watersheds), Jonah Infill Drilling Project, Wyoming, 2006.



Source: BLM (Based on data from the Wyoming Geographic Information Science Center, 2003)

Map 3.9. Cumulative Impact Assessment Area (Project-affected Watersheds) for Surface Water, Soils, Vegetation, and Fisheries, Jonah Infill Drilling Project, Wyoming, 2006.

The Colorado River Basin Salinity Control Forum is a cooperative effort between federal agencies and seven states (Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming) to address the problem of increasing salinity in the lower reaches of the Colorado River. Salinity has long been recognized as one of the major problems of the river. Salts contained within sedimentary rocks throughout the basin are easily eroded, dissolved, and transported into the river system, with salt-loading resulting from natural processes (i.e., saline springs, groundwater discharge into the river system, erosion, and the concentrating effects of evaporation and transpiration) and human-caused processes (i.e., irrigation return waters, reservoir evaporation, municipal and industrial discharges) (Colorado River Basin Salinity Control Forum 2002).

The purpose of the Colorado River Basin Salinity Control Forum is to provide information necessary to comply with Section 303(a) and (b) of the Clean Water Act and to meet national, international, and state water quality objectives (Colorado River Basin Salinity Control Forum 2002). The following measures have been identified to reduce salt loading in the Colorado River Basin:

- implementation of management practices that minimize soil disturbances, repair disturbed surface environments, and protect water quality;
- prevention of nonpoint-source salt mobilization through land-use planning, permit stipulations, land-use authorizations, best management practices, watershed protection strategies, and ecological restoration;
- control of point sources such as saline springs and seeps and abandoned flowing wells (i.e., well plugging) that yield saline water;
- implementation of water quality monitoring and analysis to assess the effectiveness of management practices;
- implementation of vegetation management practices that improve vegetative cover (i.e., controlled burns, reclamation, revegetation), control noxious weed infestations, and improvement or repair of riparian areas, thereby decreasing the amount of runoff and soil erosion and the potential amount of salt leaving an area; and
- implementation of construction and maintenance activities such as road and trail maintenance and closures, protective fencing and access control, development of springs and water sources to improve livestock distributions, and erosion control and sediment-trapping structures (Colorado River Basin Salinity Control Forum 2002).

Portions of 10 watersheds occur within the JIDPA and/or along the Burma Road: Expanded Sand Draw-Alkali Creek, Granite Wash, Reduced Upper Alkali Creek-Green River, Big Sandy River-Bull Draw, Long Draw, Upper Eighteenmile Canyon, Jonah Gulch, 140401040603, North Alkali Draw, and Southeast New Fork River-Blue Rim (see Map 3.9 and Table 3.14) (WyGISC 2003c). The Sand Draw-Alkali Creek and Upper Alkali Creek-Green River watershed boundaries were modified and renamed to reflect more accurate hydrologic boundaries, and the New Fork River-Blue Rim watershed was reduced in size and renamed to the Southeast New Fork River-Blue Rim watershed for this project to eliminate drainage areas north of the New Fork River. The Expanded Sand Draw-Alkali Creek, Granite Wash, Reduced Upper Alkali Creek-Green River, and North Alkali Draw watersheds drain to the Green River (below the confluence with the New Fork River), approximately 12 miles west of the JIDPA. The Upper Eighteenmile watershed also drains into the Green River approximately 35 miles south of the JIDPA. The Southeast New Fork

River-Blue Rim watershed drains north to the New Fork River. The Big Sandy-Bull Draw and Long Draw watersheds drain to the Big Sandy River located approximately 5 miles southeast of the JIDPA. The Jonah Gulch and 140401040603 watersheds drain to a closed basin approximately 15 miles southeast of the JIDPA.

Approximately 45% of the JIDPA is drained by the Expanded Sand Draw-Alkali Creek watershed (13,724 acres in the JIDPA), which includes Sand Draw and many other small ephemeral washes (see Maps 3.8 and 3.9 and Table 3.14). The northwest portion of the JIDPA is drained by the Granite Wash watershed (1,312 acres in the JIDPA), which includes Granite Wash, small ephemeral washes, and Wild Horse Reservoir. The Reduced Upper Alkali Creek-Green River watershed drains approximately 3,782 acres of western portions of the JIDPA. The southern portion of the JIDPA is drained by three watersheds: Upper Eighteenmile Canyon, 140401040603, and Jonah Gulch. The Upper Eighteenmile Canyon watershed (1,958 acres in the JIDPA) includes the south side of Yellow Point Ridge and East Buckhorn Draw. The portions of the Jonah Gulch (318 acres) and 140401040603 (748 acres) watersheds contained in the JIDPA consist of small ephemeral channels. Eastern portions of the JIDPA are drained by the Long Draw (5,028 acres) and Big Sandy River-Bull Draw (3,630 acres) watersheds (see Table 3.14). The 12 miles of the Burma Road outside the JIDPA cross approximately 0.6 mile (2 acres) of the Expanded Sand Draw-Alkali Creek watershed; 3.1 miles (9 acres) of Reduced Upper Alkali Creek-Green River watershed; 1.9 miles (5 acres) of the Granite Wash watershed; 2.0 miles (6 acres) of the North Alkali Draw watershed; and 4.4 miles (13 acres) of the Southeast New Fork River-Blue Rim watershed (see Table 3.14).

The current PFO RMP indicates that Sand Draw and Alkali Creek are prone to flooding (BLM 1987a, 1987b). However, flooding may occur in any of the ephemeral draws within the JIDPA after rainstorms. Drainages within the JIDPA flow only periodically in response to rain and snowmelt events, and have extended periods of no flow during most of the year.

Surface Water Quality

Alkali Creek, Sand Draw, Granite Wash, and all other named and unnamed streams in the JIDPA are Class 3B surface waters (WDEQ/WQD 2001). Class 3B waters are tributary waters including adjacent wetlands that are not known to support fish populations or drinking water supplies. They are intermittent and ephemeral streams with sufficient hydrology to normally support and sustain communities of aquatic life including invertebrates, amphibians, or other flora and fauna. Uses designated on Class 3B waters are for aquatic life (other than fish), recreation, wildlife, industry, agriculture, and scenic value.

Down-channel of the JIDPA, the Big Sandy and New Fork Rivers are Class 2AB waters (i.e., waters known to support game fish populations and where a game fishery and drinking water use is attainable) (WDEQ/WQD 2001). Uses designated for Class 2AB waters include those listed above for Class 3B plus drinking water, game and non-game fish, and fish consumption, and these waters are protected for all these uses. The Green River, downstream from the New Fork River, is also Class 2AB.

Section 303(d) of the Clean Water Act requires states to identify waters that are not supporting their designated uses and/or that need to have a total maximum daily load established to support their uses. There are no streams within the JIDPA or CIAA that are on the State of Wyoming's 2004 Section 303(d) list or included in the 2004 305(b) Report (WDEQ 2004).

The quantity of sediment and associated salt loads within ephemeral flows from the JIDPA is unknown. However, Alkali Creek and several associated watersheds outside of the JIDPA were listed in 1993 as salinity concerns by the BLM, NRCS, and University of Wyoming under the designation of "Long Island Watershed." Stream surveys of Alkali Creek downstream from the JIDPA have noted drops in the channel base level (headcuts) that, while not within the immediate area of the JIDPA, have the potential to be affected and eventually affect the channels within the JIDPA as well as the salt and sediment loads coming from the affected watersheds. Efforts are underway to address the headcuts and their effects.

Runoff modeling, including sediment and salt loading of surface waters, has been performed and used to analyze impacts to surface water quality.

Surface Water Use

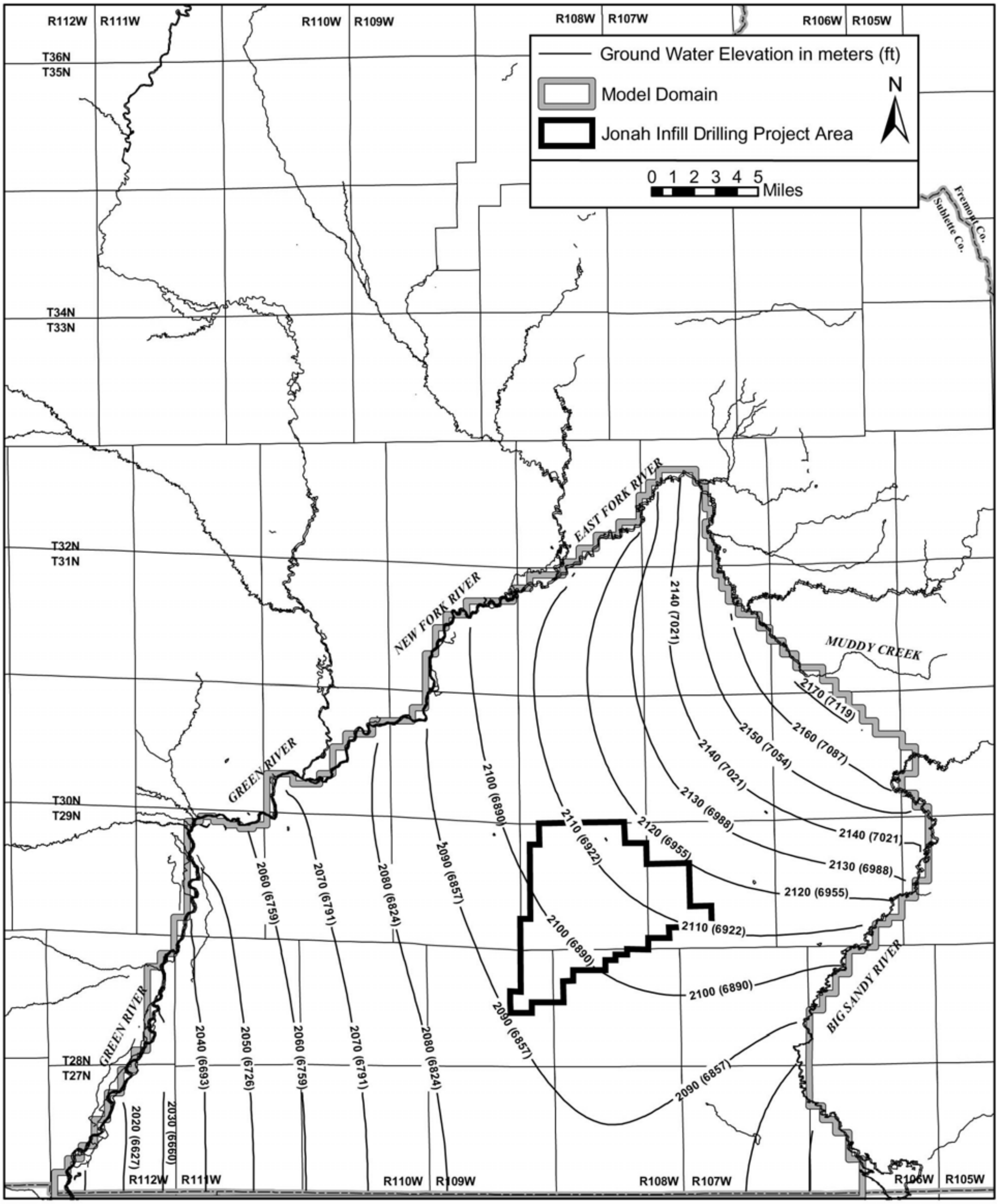
Five adjudicated and numerous unadjudicated surface water rights occur in the JIDPA (State Engineer's Office 2004). The major surface water uses in the JIDPA are for livestock and wildlife watering. Numerous impoundments and playas (internally drained, closed basins that periodically hold water) occur throughout the area. Several reservoirs (e.g., Warden, Lumen, Granite, Wild Horse, Sand Draw No. 4) have been constructed along drainages and may semipermanently, seasonally, or temporarily hold water. There are approximately 22 stock ponds scattered throughout the area. One large playa is located on private surface in Section 32, T29N, R108W. Other smaller playas or depressions occur throughout the JIDPA. No irrigation occurs on the JIDPA.

3.1.6.2 Groundwater

The JIDPA and associated groundwater CIAA (i.e., the JIDPA and adjacent potential draw-down areas) are underlain, in descending order, by the Laney and Wilkins Peak Members of the Green River Formation or the Wasatch Formation, the Fort Union Formation, an unnamed Tertiary bed, and the Lance Formation (Dynamac Corporation 2002) (see Figure 3.11). The Laney and Wilkins Peak Members of the Green River Formation contain small quantities of water (Welder 1968, Ahern et al. 1981). The Wasatch and Fort Union Formations underlying the JIDPA and the surrounding region are known to contain significant amounts of water. Unconfined aquifers occur within about 300 feet of the surface and include the upper portions of Tertiary sedimentary rocks. Confined aquifers include the lower portions of Tertiary rocks (below about 300 feet) and all underlying strata (Welder 1968). Lenses of impermeable rock occur throughout these formations, creating perched aquifers and localized aquitards (areas with restricted flows) (Doncaster pers. comm.).

The JIDPA and groundwater CIAA are located on a recharge area for the Tertiary formations, and the main sources of recharge are precipitation and seepage from streams and reservoirs (Dynamac Corporation 2002). Groundwater discharge occurs through transpiration, seepage into streams, and pumping. HydroGeo, Inc. (2004) indicates a northeast to southwest groundwater flow. Estimated steady-state groundwater levels (i.e., with no pumping) show that groundwater levels slope gently from 7,100 feet in elevation in the northeast to 6,600 feet in elevation in the southwest (Map 3.10) (HydroGeo, Inc. 2004).

The Laney Member has good potential for groundwater production (1–75 gallons per minute [gpm]), and well yields from the Wasatch Formation aquifer range from 1–3,000 gpm but



Source: HydroGeo, Inc. (2004)

Map 3.10. Estimated Steady-State Groundwater Levels (Potentiometric Surface), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

typically less than 500 gpm (Ahern et al. 1981). The Fort Union Formation is deeply buried in the JIDPA so well yield data are not available. The Lance Formation produces non-potable water as a byproduct of hydrocarbon production (referred to as produced water).

Groundwater Quality

The standard for total dissolved solids (TDS) in drinking water is 500 milligrams per liter (mg/l) (WDEQ 1990), and much of the groundwater in the area exceeds this standard. TDS is used as a general measurement of groundwater condition, but does not cover all aspects of water quality. Sandstones in the Green River and Wasatch Formations contain fresh to brackish water, with TDS concentrations of 500–100,000 mg/l. Groundwater tends to become more mineralized with increasing depth below the surface. Groundwater in the Laney Member of the Green River Formation contains 2,000–7,000 mg/l TDS. Sodium and sulfate are the main ions, and calcium ion concentrations are high. Water quality in the Wilkins Peak Member is typically poor, with TDS concentrations of 7,000–100,000 mg/l. Sodium, bicarbonate, and carbonate are the dominant ions (Welder 1968, Ahern et al. 1981). Groundwater quality in the Wasatch aquifer is highly variable and tends to decline with distance from recharge areas. These waters are predominantly a calcium-bicarbonate type where, toward the basin center, sodium and chloride replace calcium (Bruce 1993). To a depth of about 2,300 feet, groundwater in the Wasatch Formation has a TDS content of about 640 mg/l. At a depth of 5,000 feet, TDS concentrations are about 21,000 mg/l; this disparity suggests that these waters occur in different aquifers within the Wasatch Formation (Bain pers. comm.).

Natural gas well logs from existing wells in the JIDPA indicate that the Fort Union and Lance Formations contain discrete water-bearing sandstones, with water quality ranging from brackish to saline and TDS typically averaging 2,000–5,000 mg/l, within the range of 1,722–28,476 mg/l (Table 3.15). The groundwater standards for TDS are 500 mg/l for domestic use, 2,000 mg/l for agricultural use, and 5,000 mg/l for livestock use, so untreated produced water is not suitable for domestic use, is only marginally suited for agricultural, but is suitable for livestock use.

Chloride concentrations in produced waters exceeded state groundwater standards for domestic and agricultural use and for livestock use in three of the wells tested. Chloride concentrations range from 290–18,300 mg/l (see Table 3.15), whereas the standard for domestic use is 250 mg/l, for agricultural use is 100 mg/l, and for livestock use is 2,000 mg/l.

Iron concentrations also exceeded standards for domestic use (0.3 mg/l) and agricultural use (5.0 mg/l) in at least 18 and 13 of the wells sampled, respectively.

Groundwater Use

Groundwater in the JIDPA and CIAA contributes only a small fraction (less than 2.5%) of the water used in the Green River Basin (Ahern et al. 1981). Groundwater in the JIDPA and CIAA is primarily used for oil and gas development and stock and wildlife watering. At present, more than 130 recognized groundwater permits are assigned to approximately 25 existing groundwater wells within the JIDPA. The majority of these permits are for existing oil and gas development use (State Engineer's Office 2004). The location of groundwater wells is provided in Chapter 4 (see Map 4.1). No groundwater irrigation occurs in the JIDPA or CIAA.

Table 3.15. Produced Water Quality, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

	Constituent													
	pH	Chloride	Sulfate	TDS	Carbonate	Bicarbonate	Conductivity	Sodium	Potassium	Calcium	Magnesium	Iron	Barium	Boron
Evaporation Pond	7.8	2,153	51	4,752	0	747	6,950	1,051	83	651	6.02	<2.09	6.01	2.67
Well No.														
SHB 3-34	6.50	18,300	5	28,476	0	139	39,100	3,190	7,304.0	6,850.00	18.10	58.50	6.0	--
JF 1-5X	7.72	520	99	3,004	0	1,148	3,850	964	41.3	22.50	4.23	43.50	<0.1	--
YP 2-1	7.81	470	12	3,208	0	1,441	4,060	1,040	17.9	11.90	2.04	4.97	<0.1	--
JF 2-8X	7.06	480	11	2,694	0	934	3,350	839	28.5	12.20	1.40	54.40	<0.1	--
CAB 2-25	7.63	970	58	3,656	0	961	4,690	1,090	32.0	11.60	1.25	60.30	<0.1	--
SHB 2-33	7.71	460	29	2,486	0	907	3,200	801	20.7	12.30	1.13	15.50	<0.1	--
YP 4-24	7.45	2,329	128	6,434	0	1,121	7,770	1,180	81.5	9.31	1.92	9.48	<0.1	--
SHB 4-34	7.81	470	33	3,200	0	1,308	4,170	1,025	43.2	17.60	2.64	<0.68	<.1	--
JF 5-4	7.94	430	30	2,752	0	1,148	3,650	900	17.7	9.45	1.69	<0.68	<0.1	--
SHB 7-35	7.48	1,520	29	3,746	0	552	5,710	1,050	35.1	22.00	3.88	<0.68	<0.1	--
JF 4-18	7.91	430	45	2,634	0	1,201	3,450	878	12.0	6.92	0.60	9.48	<0.1	--
SHB 5-34	7.79	710	58	3,126	0	1,121	4,210	992	61.1	17.90	2.81	4.70	<0.1	--
YP 8-13	8.05	350	18	2,462	0	1,174	3,250	793	7.8	6.50	1.06	<0.68	<0.1	--
YP 9-12	6.38	1,500	15	2,848	0	214	4,850	884	15.9	37.00	6.25	56.00	<0.1	--
YP 10-11	7.87	290	23	2,154	0	854	2,670	640	8.64	17.50	1.07	<0.68	<0.1	--
CSHB 10-31	8.00	600	34	3,552	0	1,521	4,640	1,160	28.6	15.30	4.18	<0.68	<0.1	--
JF 11-7	8.00	340	29	2,192	0	881	2,890	654	10.2	6.16	1.15	0.86	<0.1	--
SHB 11-20	7.97	1,300	48	4,740	0	1,575	6,620	1,540	2,108.0	1,208.00	2.38	8.39	<0.1	--
SHB 11-28	7.90	1,150	63	4,260	0	1,201	5,860	1,280	67.0	29.50	4.38	<0.68	<0.1	--
CAB 12-19	7.95	910	45	2,996	0	827	4,500	993	21.3	13.80	3.45	3.56	<0.1	--
SHB 12-27	7.94	450	34	2,850	0	1,041	3,600	854	13.1	14.10	2.06	1.56	<0.1	--
SHB 13-17	8.07	2,100	24	5,084	0	623	5,530	1,470	14.2	37.80	6.88	10.50	<0.1	--
SHB 13-32	7.78	950	16	2,088	0	240	2,760	630	58.4	18.10	2.90	<0.68	<0.1	--
CAB 14-30	7.52	390	49	1,722	0	534	2,420	535	18.3	5.80	1.18	45.40	<0.1	--
SHB 16-26	8.05	790	7	2,954	0	694	4,010	868	12.3	10.10	1.36	26.70	<0.1	--
SHB 31-36	8.07	960	30	4,062	0	1,201	5,100	1,120	32.5	8.55	1.20	43.00	<0.1	--

[1] Data provided by EnCana. See also Appendix B.

3.1.7 Noise and Odor

The noise CIAA includes the JIDPA and surrounding 20-mile area. Noise levels depend on the loudness and pitch of the source, the listener's distance from the source, air temperature, humidity, turbulence, wind gradient, and the screening effects of terrain. Existing natural gas development activities in the JIDPA generate noise through well pad, road, and pipeline construction; flaring, drilling, and facility operations; vehicle traffic; and site reclamation. Drilling rig and well testing (fracturing and flaring) operations produce noise levels of up to 115 A-weighted decibels (dBA) (constant exposure endangers hearing), with a noise level of 55 dBA (which is considered quiet) at 3,500 feet (0.66 mile) from the source (BLM 1991b). Typical natural gas development noise levels are provided in Figure 3.13, and Table 3.16 provides example noise levels for commonly heard sounds. Flaring (one component of completion operations) tends to be the loudest noise event; however, with the use of flowback separators, noise from completion operations is reduced to approximately 64 dBA at the source.

Noise levels at the Luman compressor station, just south of the JIDPA, are about 69–86 dBA at the compressor station, 58–75 dBA about 1.0 mile to the southeast, and 54 dBA about 1.25 miles to the southeast (TRC Mariah 2003a). Noise levels at the Falcon compressor station, just north of the JIDPA, are about 77 dBA at the compressor station and about 65 dBA about 1.0 mile east. Noise levels associated with construction activities range from 70 dBA (similar to busy traffic) to over 90 dBA within 50 feet of the activity; however, these noise levels attenuate with distance with a reduction of approximately 6 dBA with each doubling of distance (Thuman and Miller 1996). While it is likely that noise from existing natural gas operations in the JIDPA during certain weather conditions (low winds) may be heard 20 or more miles from the area (outside the CIAA), noise levels at this distance are expected to be very quiet to barely audible (see Table 3.16). Background noise levels in the JIDPA are between 29 and 38 dBA (TRC Mariah 2001a, 2003a) but may be higher depending on wind conditions.

Outside development areas, noise levels can be characterized as rural or natural. Wind, thunderstorms, livestock, and wildlife (primarily passerine birds) are the primary noise sources, except for the occasional vehicle or aircraft.

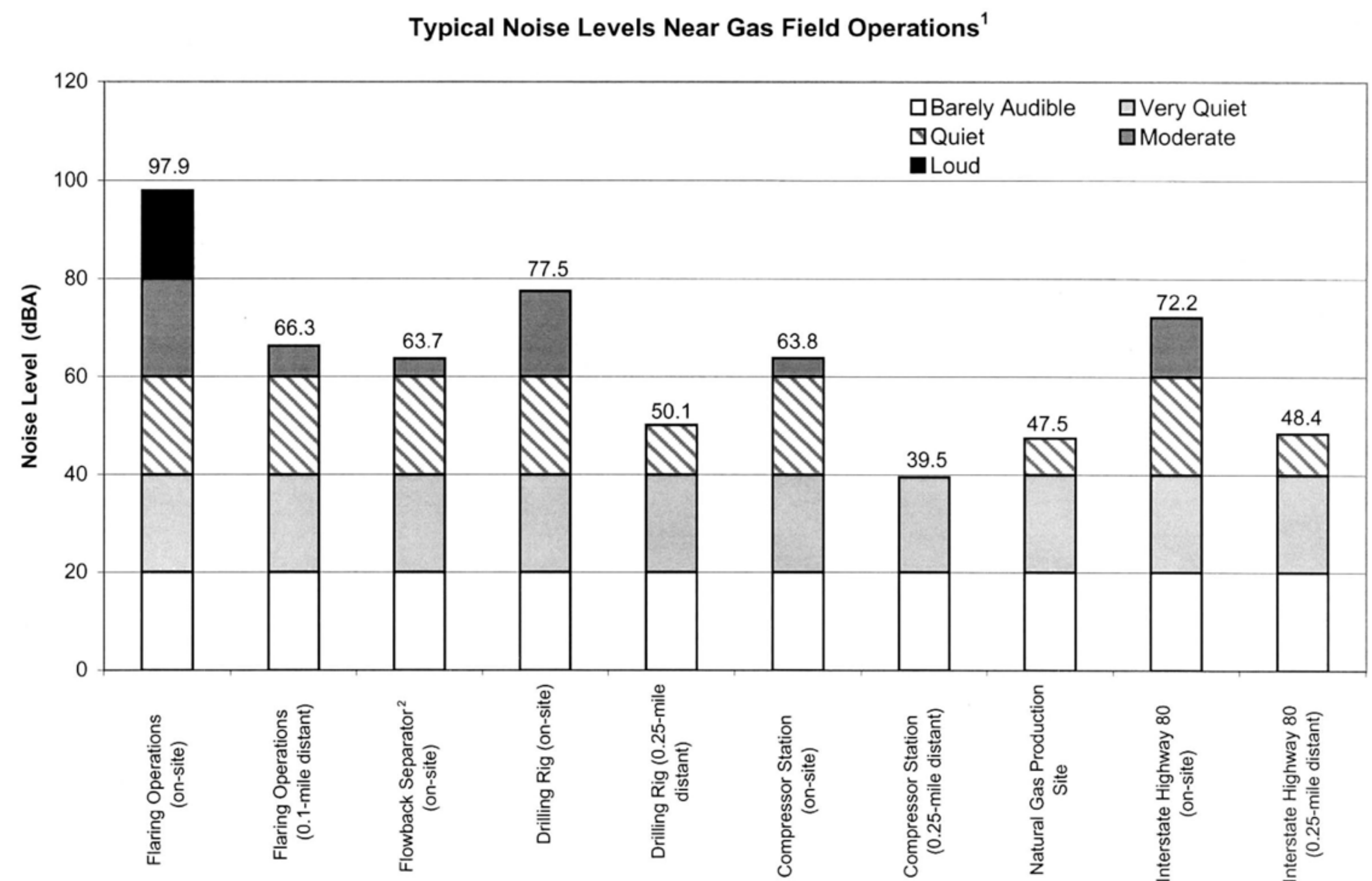
Noise-sensitive areas in the JIDPA include greater sage-grouse leks during the breeding season and occupied greater sage-grouse and raptor nests. No residences occur in or immediately adjacent to the area.

Table 3.16. Comparison of Measured Noise Levels with Commonly Heard Sounds, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Source	dBA[2]	Description
Normal breathing	10	Barely audible
Rustling leaves	20	
Soft whisper (at 16 feet [5 meters])	30	Very quiet
Library	40	
Quiet office	50	Quiet
Normal conversation (at 3 feet [1 meter])	60	
Busy traffic	70	Moderately noisy
Noisy office with machines; factory	80	
Heavy truck (at 49 feet [15 meters])	90	Loud

[1] Adapted from Tipler (1991).
[2] dBA = A-weighted decibels.

No specific data on odors are available from the JIDPA or the surrounding 2-mile CIAA area; however, odors present in the area, other than the natural odors of vegetation and wildlife, include those from vehicle emissions along roads, natural gas development, activities at well sites, compressor stations, other ancillary facility sites, and livestock. Odors are likely to be quickly dispersed by the wind.



[1] Adapted from BLM (1999c).

[2] Data collected at JIDPA (Jonah Federal 5-7) on September 28, 2003.

Figure 3.13. Typical Natural Gas Field Noise Levels, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

3.2 BIOLOGICAL RESOURCES

3.2.1 Vegetation

3.2.1.1 Plant Communities

The CIAA for vegetation resources is the 10 watersheds, encompassing approximately 210,300 acres, that drain the JIDPA (see Map 3.9). Wyoming big sagebrush is the predominant vegetation type based on 1:100,000 scale mapping of the CIAA (WyGISC 2003b) (Table 3.17). Based upon WyGISC digital data and aerial photographs of the CIAA, approximately 1.6% (3,355 acres) of the area has been disturbed by well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residences (i.e., ranches) (see Table 3.11). At 4.2% (992 acres), the Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance, the majority of which is from natural gas development in the JIDPA (665 acres), of any of the watershed in the CIAA.

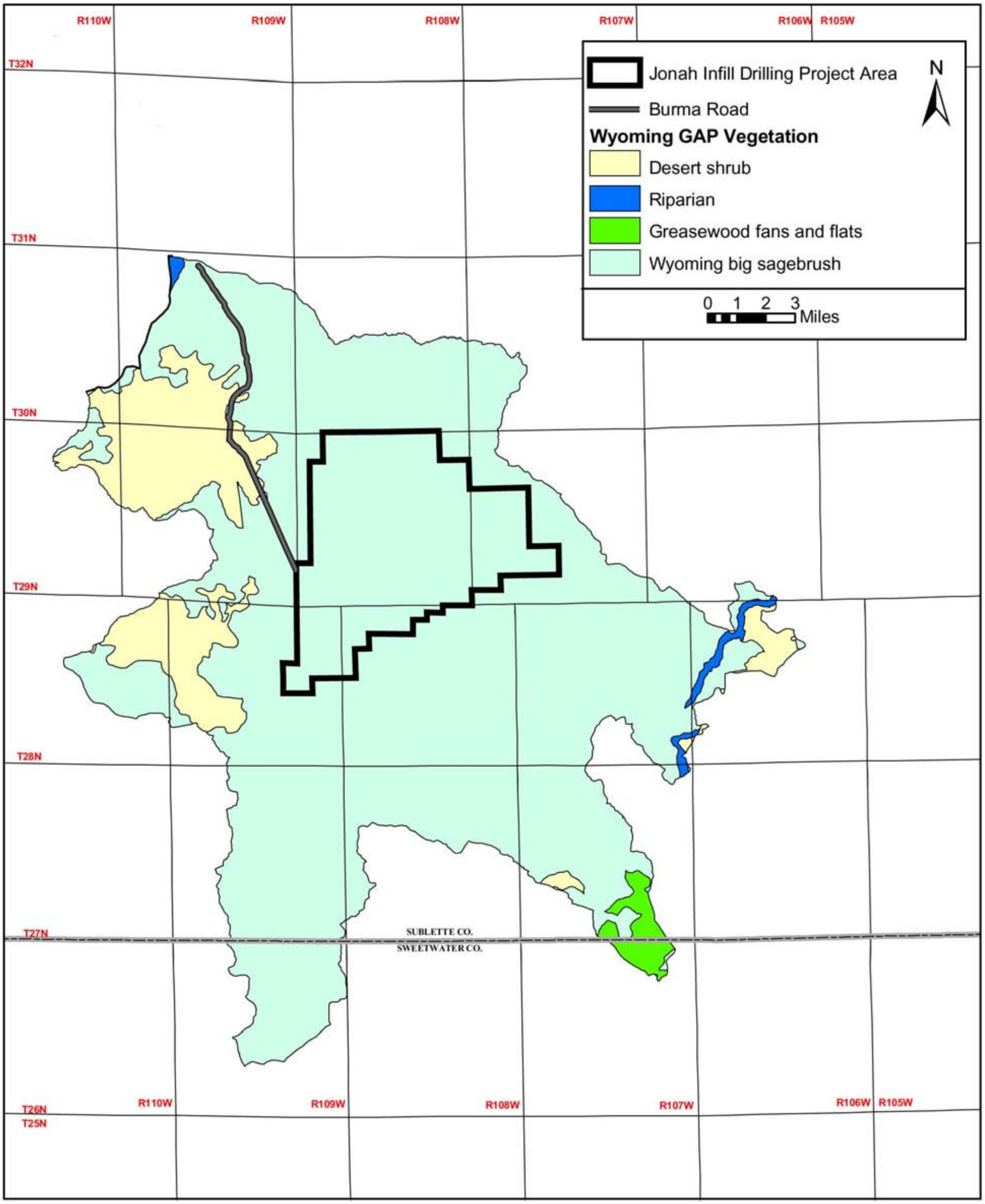
Vegetation in the JIDPA and CIAA (the same CIAA as for soils and other surface water; see Sections 3.1 and 3.16) is dominated by Wyoming big sagebrush grasslands. Included in this vegetation type are saltbush and cushionplant communities (BLM 1987b, Intermountain Ecosystems LC 1996, TRC Mariah 2001a, WyGISC 2003b) (Map 3.11, see Table 3.17). Important plants in the Wyoming big sagebrush grasslands include Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), western wheatgrass (*Elymus smithii*), thickspike wheatgrass (*Elymus lanceolatus*), Sandberg bluegrass (*Poa secunda* var. *secunda*), winterfat (*Kraschenninikovia lanata*), granite prickly gilia (*Leptodactylon pungens*), Hood's phlox (*Phlox hoodsii*), stemless goldenweed (*Haplopappus acaulis*), and rabbitbrush (*Chrysothamnus* spp.) (Fertig 1993). Needle-and-thread (*Stipa comata*) and Indian ricegrass (*Oryzopsis hymenoides*) are major species on sandy soils (TRC Mariah 2001a).

In an effort to define optimal greater sage-grouse nesting and brood-rearing areas in the JIDPA (Map 3.12, Table 3.18), the Wyoming big sagebrush grassland type was further delineated into three sagebrush habitat types during habitat mapping: moderate-density sagebrush, low-density sagebrush, and basin big sagebrush (TRC Mariah 2001a).

- Moderate-density sagebrush (formerly referred to as dense sagebrush) was the most common habitat type, occupying approximately 87.2% (26,601 acres) of the JIDPA. This habitat type generally occurs on flat to rolling terrain and generally exhibits sagebrush cover of >20% (n = 15).

- The low-density sagebrush (formerly referred to as moderate-density sagebrush) type occupies approximately 8.9% (2,721 acres) of the JIDPA (see Table 3.18). This habitat type primarily occupies slopes in the southeastern portion of the project area. Sagebrush cover in this type is approximately 6–8% of the total vegetative cover (n = 15) (TRC Mariah 2001a). Grass and forb species composition is generally similar to that in the dense sagebrush habitat type; however, Gardner's saltbush (*Atriplex gardneri*), winterfat, and spiny hopsage (*Grayia spinosa*) are more common.

- The basin big sagebrush (*Artemisia tridentata tridentata*) type occupies less than 0.1% (47 acres) of the JIDPA. Sagebrush canopy cover in this type is approximately



Source BLM (Based on data from the Wyoming Geographic Information Science Center (2003) & TRC Mariah (2001))

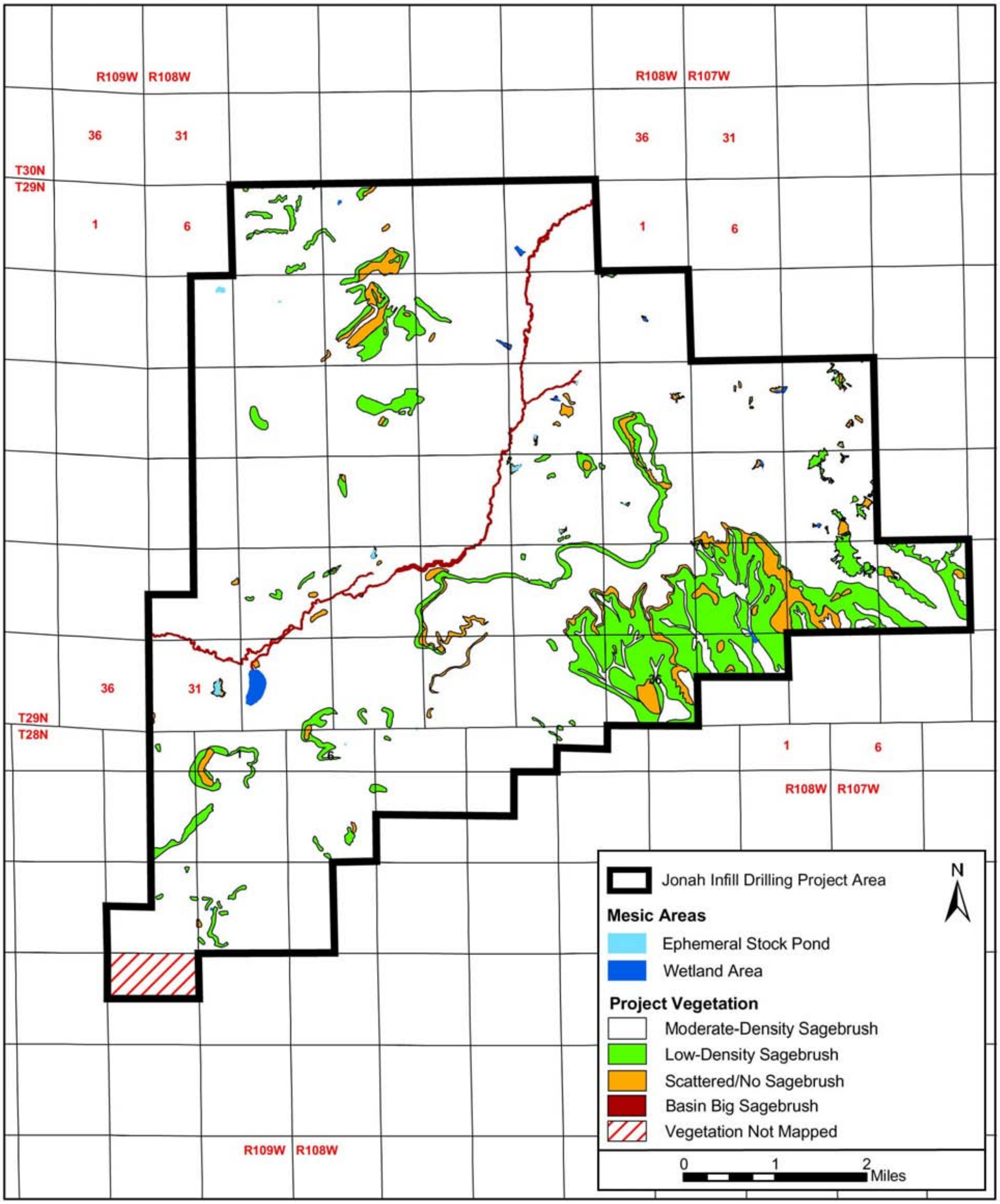
Map 3.11. Vegetation Communities (Course-Scale) in the Jonah Infill Drilling Project Area and Cumulative Impact Assessment Area, Sublette and Sweetwater Counties, Wyoming, 2006.

Table 3.17. Acreages of Vegetation Communities in the CIAA and Vegetation Types in the JIDPA, Sublette and Sweetwater Counties, Wyoming, 2006

	Hydrologic Unit Watersheds										
	Expanded Sand Draw-Alkali Creek	Granite Wash	Reduced Upper Alkali Creek-Green River	Upper Eighteenmile Canyon	Southeast New Fork River-Blue Rim	North Alkali Draw	Big Sandy River-Bull Draw	Long Draw	Jonah Gulch	140401-040603	Total
CIAA Vegetation Communities[1]											
JIDPA											
Wyoming big sagebrush	13,724	1,312	3,781	1,957	0	0	3,632	5,028	317	748	30,500
Outside JIDPA											
Wyoming big sagebrush	9,648	3,081	14,681	32,532	10,678	10,289	13,207	13,492	22,179	20,943	150,730
Desert shrub	0	7,819	7,892	722	843	5,623	1,805	0	0	369	25,073
Greasewood fans and flats	0	0	0	0	0	0	0	0	155	2,497	2,652
Riparian (shrub and forest)	0	0	0	0	225	0	1,119	1	0	0	1,345
Subtotal	9,648	10,900	22,573	33,254	11,746	15,912	16,131	13,493	22,334	23,809	179,800
Total	23,372	12,213	26,354	35,211	11,746	15,912	19,763	18,521	22,651	24,557	210,300
JIDPA Vegetation Types[2]											
Scattered/ no sagebrush	170	21	110	15	0	0	61	371	2	0	750
Low density sagebrush	404	76	223	118	0	0	320	1,566	8	6	2,721
Moderate density sagebrush	13,053	1,211	3,448	1,504	0	0	3,247	3,089	307	742	26,601
Basin big sagebrush	47	0	0	0	0	0	0	0	0	0	47
Wetlands	42	1	0	0	0	0	2	2	0	0	47
Ephemeral stockponds	8	3	0	0	0	0	2	0	0	0	13
Unmapped vegetation	0	0	0	320	0	0	0	0	0	0	320
Total	13,724	1,312	3,781	1,957	0	0	3,632	5,028	317	748	30,500

[1] Vegetation types based on Wyoming GAP Analysis land cover for Wyoming (WyGISC 2003b).

[2] Vegetation types based on TRC Mariah (2001a).



Source: BLM (Based on data from TRC Mariah, 2001)

Map 3.12. Project Area Vegetation Types (Finely Mapped), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

Table 3.18. Vegetation Data, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Parameter	Vegetation Type[2]		
	Moderate-Density Sagebrush (n = 15)	Low-Density Sagebrush (n = 15)	Basin Big Sagebrush (n = 5)
Sagebrush height (inches)	9.8	7.9	31.0
Percent sagebrush cover			
Daubenmire	21.7	6.5	30.8
Line intercept	24.5 (99%)	7.9 (89%)	36.7 (79%)
Percent total shrub cover			
Daubenmire	22.0	6.8	31.4
Line intercept	24.7 (99%)	8.1 (92%)	38.0 (80%)
Grass/forb height (inches)	5.6	6.5	6.5
Percent grass and forb cover	10.6 (89%)	15.1 (96%)	20.1 (65%)
Residual grass height (inches)[3]	6.3	6.1	6.5
Percent residual grass cover	8.5	10.9	20.1
Sagebrush plants/acre	7,260 (99%)	2,636 (92%)	4,494 (86%)
Total shrubs/acre	7,665 (99%)	2,951 (96%)	5,088 (91%)

[1] Adapted from TRC Mariah 2001a. Data on file at TRC Mariah, Laramie, Wyoming. Measurements recorded in late summer 2000.
[2] See Map 3.12 for type locations. Numbers in parentheses are the confidence level achieved with 80% precision using the appropriate z statistic.
[3] Excludes pre-2000 litter.

30–38% (n = 5) (see Table 3.18). This type occurs as a narrow strip from less than 5 feet wide to approximately 150 feet wide along the Sand Draw drainage, where basin big sagebrush is the dominant species. The understory is relatively sparse, with scattered rabbitbrush, western and thickspike wheatgrasses, Sandberg bluegrass, and Great Basin wildrye (*Elymus cinereus*).

The scattered/no sagebrush habitat type (2.5% of the JIDPA, 750 acres) contains saltbush and cushionplant communities. The saltbush communities support Gardner's saltbush, shadscale (*Atriplex confertifolia*), bud sagebrush (*Artemisia spinescens*), winterfat, and western wheatgrass and generally occur on level lowland topographic locations or are associated with playas. The cushionplant communities, which are characterized by the near absence of big sagebrush and low overall vegetative cover, generally occupy rocky outcrops, ridgetops, or steep slopes. Dominant species in the cushionplant community include fringed sagebrush (*Artemisia frigida*), squarestem phlox (*Phlox muscoides*), spoonleaf milkvetch (*Astragalus spatulatus*), goldenweed (*Haplopappus* spp.), Hooker sandwort (*Arenaria hookeri*), cutleaf daisy (*Erigeron compositus*), mat beardtongue (*Penstemon caespitosus*), and silky locoweed (*Oxytropus sericea*). This habitat type also includes barren side slopes and fans derived from clay and shale substrates.

Approximately 4,200 acres of the JIDPA have been authorized for surface-disturbance activities based on existing Jonah NEPA documents. An estimated 3,500 acres have already been disturbed. Of this total, approximately 2,800 acres are in various stages of reclamation, but approximately 1,400 acres are anticipated to remain for another 40 to 60 years.

3.2.1.2 Riparian and Wetland Areas

Riparian plant communities are contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent water bodies (rivers, streams, lakes, or drainageways) and are usually transitional between wetland and upland communities. Riparian areas generally exhibit distinctly different vegetative species than adjacent areas and/or vegetative species similar to adjacent areas but exhibit more vigorous or robust growth forms (U.S. Fish and Wildlife Service [USFWS] 1997). Based on this definition, no riparian communities occur within the JIDPA. However, riparian communities are present in the CIAA along the New Fork and Big Sandy Rivers.

Wetlands are protected under Section 404 of the Clean Water Act (33 CFR 1251 et seq.) and EO 11990, and are considered sensitive and valuable resources. The current regulatory definition of wetlands for administrating the Clean Water Act Section 404 permit program for dredge and fill activities is “areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and [which] under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (U.S. Army Corps of Engineers [COE] 1987, Wetlands Training Institute, Inc. 1995). A wetland must possess the following three general diagnostic characteristics:

- Hydrophytic vegetation – The prevalent vegetation consists of macrophytes that are typically adapted to areas having hydrologic and soil conditions described in the wetland definition above. That is, they are adapted to actively grow in saturated soils.

- Hydric soil – Soils are present and have been classified as hydric, or they possess characteristics that are associated with reducing (often saturated) soil conditions.

- Hydrology – The area is inundated either permanently or periodically at mean water depths less than or equal to 6.6 feet, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation.

In 2003, field investigations were conducted to verify the wetland designations indicated on existing USFWS National Wetland Inventory (NWI) maps of the JIDPA. The maps generally proved to be accurate in the classification and location of wetlands; however, many of the mapped NWI sites may not be subject to regulation under Section 404 due to a lack of the three general diagnostic environmental characteristics described above. While some of the NWI-identified wetlands lack one or more of the regulatory requirements (i.e., dominance of hydrophytic vegetation, hydric soils, or wetland hydrology), these areas provide unique habitats for wildlife, as well as water for both wildlife and livestock, throughout all or part of the year. Approximately 13 acres of the NWI-identified wetland areas within the JIDPA are ephemeral stockponds (see Table 3.17 and Map 3.12). Approximately 47 acres (<0.1% of the JIDPA) of potentially jurisdictional wetlands (i.e., regulated under Section 404) occur within the JIDPA (see Map 3.12). These areas are generally classified as palustrine emergent seasonally or semipermanently flooded wetlands on the NWI maps and are primarily associated with stockponds and reservoirs. These wetlands generally range in size from 0.1 acre to 2.1 acres. The largest reservoirs in the area (e.g., Sand Draw No. 4 and Wild Horse) are classified as temporarily, seasonally, or semipermanently flooded and are 5 to 10 acres in size. A large playa located on private land in Section 32, T29N, R108W, is classified as temporarily or seasonally flooded and occupies approximately 36 acres. There are also several small depressions or playas less than one acre in size and classified as palustrine unconsolidated shore, temporarily, seasonally, or semipermanently flooded wetlands in the area.

Waters of the U.S. (WUS) have an active channel that exhibits relatively stable characteristics; the criterion for a WUS is the presence of a defined bed and bank. The boundary of a WUS extends to the ordinary high-water mark or to the boundaries of adjacent wetlands. Intermittent and ephemeral streams that exhibit a defined bed and bank qualify as WUS, as do reservoirs constructed on these streams.

Numerous ephemeral channels, considered WUS by the COE and classified on the NWI maps as riverine intermittent streambed temporarily flooded, occur in the JIDPA (see Map 3.8). Bed channel widths range from 1 foot to more than 30 feet along Sand Draw, the largest ephemeral drainage in the JIDPA.

3.2.1.3 Noxious Non-Native, and Invasive Plant Species

The Wyoming State Legislature enacted the Wyoming Weed and Pest Control Act in 1973 for the purpose of controlling designated weeds and pests. EO 13112, "Invasive Species," was signed by President Clinton on February 3, 1999, to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause. Potential invader species (which include noxious weeds) identified by the Sublette County Weed and Pest Control for the JIDPA and vicinity include black henbane (*Hyoscyamus niger*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), Dyer's woad (*Isatis tinctoria*), spotted knapweed (*Centaurea maculosa*), hoary cress (*Cardaria draba* and *C. pubescens*), perennial pepperweed (*Lepidium latifolium*), Russian knapweed (*Centaurea repens*), and perennial sow thistle (*Sonchus arvensis*). Sources of invasion include gravel obtained from outside the JIDPA and soil carried to the area on vehicles and drilling and construction equipment.

A reconnaissance of the JIDPA in 2003 found Russian thistle (*Salsola kali*) and halogeton (*Halogeton glomeratus*) establishment on reclaimed areas (i.e., well pads, pipeline and road ROWs) reseeded from 1992 through 2002. Though Russian thistle and halogeton are not identified as noxious weeds by Sublette County Weed and Pest Control, they are generally considered undesirable for livestock and wildlife forage (Stubbendieck et al. 1997).

3.2.2 Wildlife and Fisheries

3.2.2.1 Big Game/Other Mammals

Pronghorn antelope is the only big game species that regularly inhabits the JIDPA. Occasionally, mule deer have been observed in the area (TRC Mariah 2004a), but no range designation for mule deer has been delineated on the JIDPA by the WGFD, so mule deer are not discussed further.

The WGFD determines range classifications for big game species and is in the process of revising big game ranges across the state. This revision is not complete for the big game herds in the JIDPA; therefore, the range designations that have been in place for the last several years are used in this EIS.

Pronghorn Antelope

The entire JIDPA is within spring/summer/fall range of the Sublette Pronghorn Antelope Herd Unit and is identified as the Herd Unit CIAA. This Herd Unit occupies approximately 10,546 square miles and includes most of the Green River drainage north of Interstate 80, exclusive of the Black's Fork and Ham's Fork drainages (Map 3.13). Approximately 3,006,000 acres (4,697 square miles) of the Sublette Herd Unit CIAA is designated as spring/summer/fall habitat. Limited portions of other drainages, including the Gros Ventre/Hoback River area near Jackson Hole, are also included in the Sublette Herd Unit. Within these boundaries, the Sublette Herd Unit pronghorn migrate farther between seasonal ranges than any other pronghorn in Wyoming, with documented movements of as much as 150 miles between several ranges (WGFD 2001). WGFD has documented migration corridor occurrence within and adjacent to the JIDPA (Map 3.13).

Total existing disturbance (from roads, wells, towns) within the Herd Unit CIAA is approximately 87,200 acres (136 square miles) or 1.3% of the total Herd Unit. Though no pronghorn crucial range occurs within the JIDPA, the Burma Road passes through some pronghorn crucial winter range. Approximately 27,200 acres (2.5%) of pronghorn crucial range in the Sublette Herd Unit have been disturbed. BLM is responsible for the majority of surface management in the Sublette Herd Unit. Other surface management entities include the USFS, the Bureau of Reclamation, the State of Wyoming, and private entities.

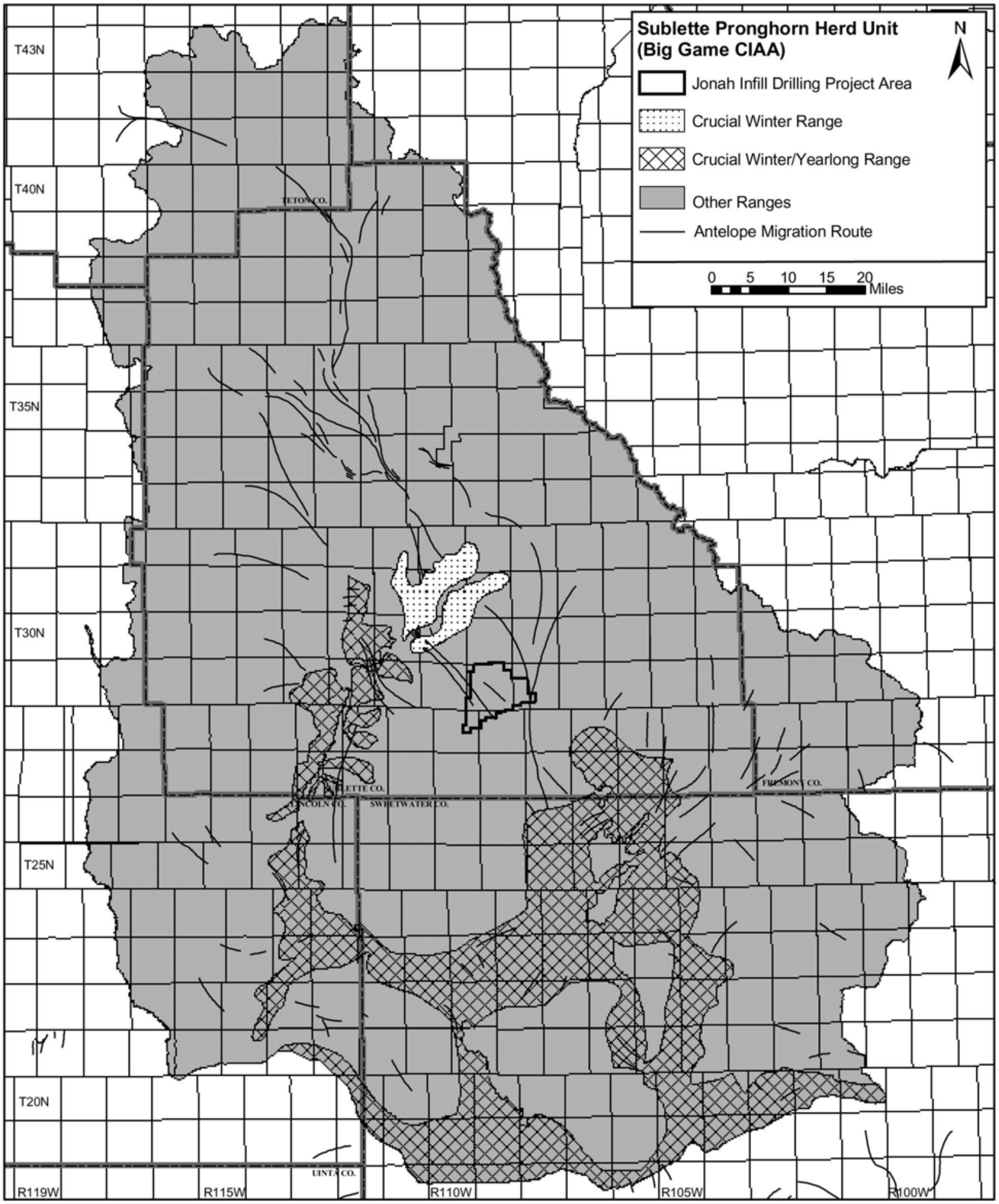
The WGFD population objective for the Sublette Herd Unit is 48,000 pronghorn antelope. The 2002 population was estimated at 44,700 (93% of the current objective), and the estimated population averaged 44,080 from 1997 to 2001 (WGFD 2002). Because of its large size, the Sublette Herd Unit has been divided into three subunits. The JIDPA is within the North subunit, which has a population objective of 22,000 and an estimated 2001 population of 18,600 (84.5% of objective). The population trend in the North subunit has been relatively stable in recent years, ranging from 17,900 head in 1998 to 19,700 in 1994 (WGFD 2001).

Reproductive success of the Sublette North subunit from 1985 to 2001 has been highly variable, ranging from 45 fawns/100 does in 1993 to 90 fawns/100 does in 1987. Fawn/doe ratios in 2000 and 2001 were toward the low end of the range at 53/100 and 55/100, respectively (WGFD 2001). Drought conditions from 2000 to 2003 have reduced forage production and available water throughout the Sublette Herd Unit. Low summer precipitation typically results in poor body condition and subsequently, poor fawning rates and overwinter fawn survival (WGFD 2001).

Other Wildlife

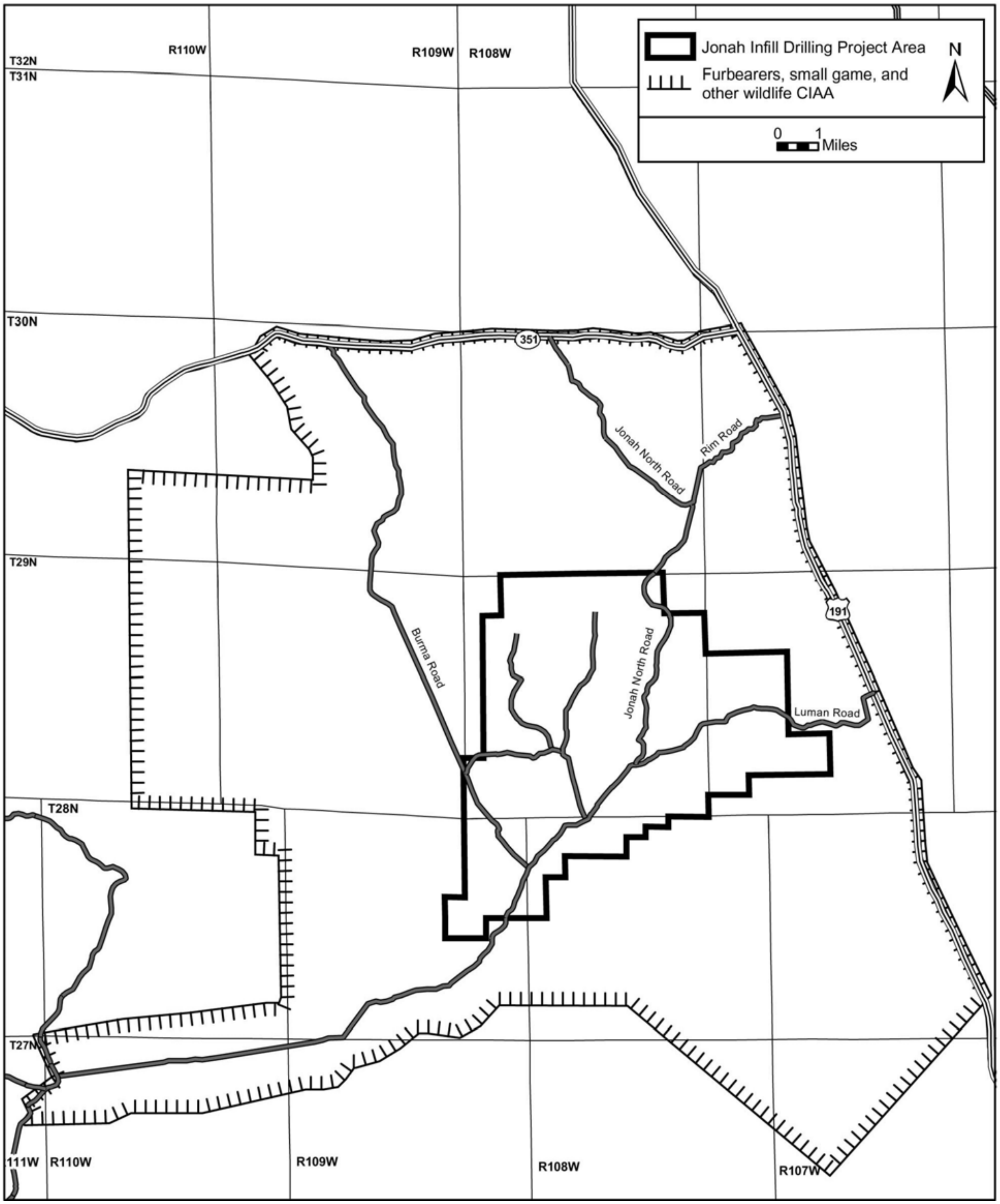
The CIAA for other wildlife encompasses approximately 188,888 acres (295 square miles) (Map 3.14). Existing disturbance within the CIAA includes approximately 2,729 acres (4.3 square miles), or 1.4% of the CIAA, and results primarily from road and pipeline ROWs (44%) and existing long-term disturbance in the JIDPA (52%).

Other mammals known or likely to occur in the JIDPA based on observations and range and habitat preferences (Clark and Stromberg 1987, WGFD 1999, WyNDD 2003) include: dwarf shrew, 10 bat species (California myotis, small-footed myotis, Yuma myotis, little brown myotis, long-legged myotis, silver-haired bat, big brown bat, hoary bat, Townsend's big-eared bat, and pallid bat); four species of hares and rabbits (pygmy rabbit, Nuttall's cottontail, desert cottontail, and white-tailed jackrabbit); five squirrel species (least chipmunk, Uinta ground squirrel, Wyoming ground squirrel, thirteen-lined ground squirrel, and white-tailed prairie dog); northern



Source: BLM (Including data from Wyoming Game & Fish Dept, 2001)

Map 3.13. Sublette Herd Unit and Pronghorn Migration Routes, Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



Source: BLM

Map 3.14. General Wildlife Species Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

and Idaho pocket gophers; six species of new world rats and mice (Ord's kangaroo rat, deer mouse, grasshopper mouse, bushy-tailed woodrat, sagebrush vole, and long-tailed vole); coyote and red fox; four mustelid species (long-tailed weasel, badger, western spotted skunk, and striped skunk); and bobcat. Porcupines have been observed in the vicinity of the project area but are uncommon and not likely to be residents.

All identified prairie dog colonies on the JIDPA have been mapped. Colonies vary from 6 to 893 acres in size (Map 3.15) and are visited annually during wildlife surveys conducted for the Jonah Wildlife Studies Project (TRC Mariah 2004a). During these studies, newly observed colonies are mapped, and regular updates to colony boundaries are made.

3.2.2.2 Birds

Raptors

The CIAA for raptors encompasses approximately 1,184,443 acres (1,850 square miles) (Map 3.16). Existing disturbance within this CIAA is approximately 113,092 acres (176 square miles), or 9.5% of the area. This disturbance is primarily from agriculture (88%) and road and pipeline ROWs (8%).

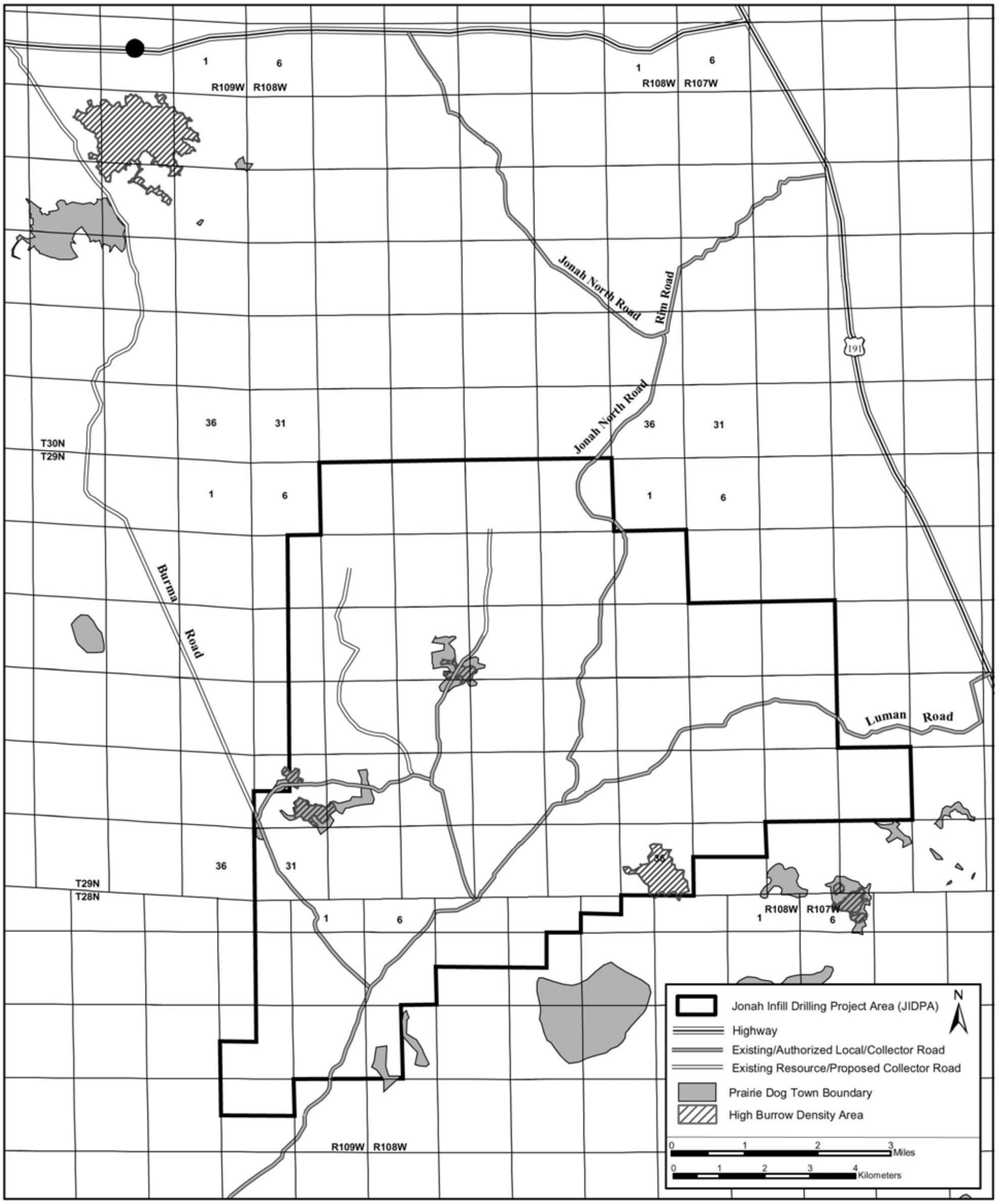
Based on geographic range and habitat preferences, a variety of raptor species may occur within the JIDPA (Dorn and Dorn 1999, WGFD 1999). Raptor nest surveys are conducted annually on the JIDPA and within the greater Jonah Wildlife Study Area (TRC Mariah 2004a). All known raptor nests/nest sites are inventoried, and other suitable nesting habitat is observed to determine if there are new nests in the area (Map 3.17). These inventories have revealed declines in the number of active ferruginous hawk nests on and adjacent to the JIDPA over the last 8 years.

Approximately 35 raptor nests are known to occur within the JIDPA. In 2004, seven nests were occupied, including five American kestrel nests, one ferruginous hawk nest, and one burrowing owl nest. In addition to the seven occupied nests, nine other nests on the JIDPA are considered active (i.e., occupied at least once during the last 3 years or having an unknown status) for management purposes. These include four ferruginous hawk, one American kestrel, and one burrowing owl nest. Approximately 19 known nests within the JIDPA have had no recent activity or use. A detailed analysis of raptor nesting history in the area is provided in *2003 Wildlife Studies, Jonah Field II Natural Gas Development Project* (TRC Mariah 2004a).

Game Birds

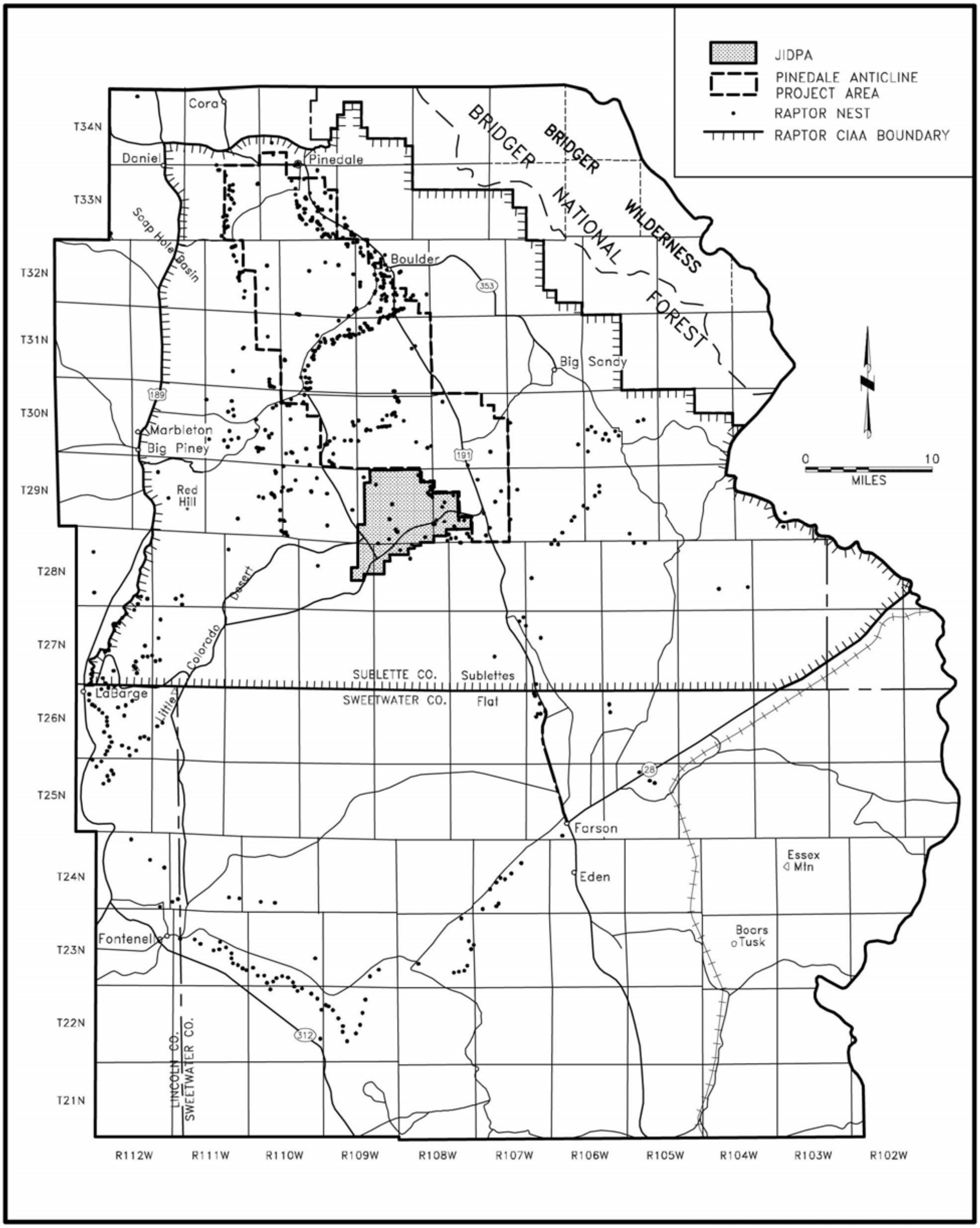
The principal upland game bird inhabiting the JIDPA is greater sage-grouse. A detailed summary of known greater sage-grouse lek activity on the JIDPA is provided in *2003 Wildlife Studies, Jonah Field II Natural Gas Development Project* (TRC Mariah 2004a). The CIAA for greater sage-grouse encompasses 1,061,805 acres (1,659 square miles) (Map 3.18). Existing disturbance within this CIAA includes approximately 28,767 acres (45 square miles), or 2.7% of the CIAA, and results primarily from agriculture (70%) and road and pipeline ROWs (21%).

Greater sage-grouse has been extirpated from two states and populations over the remainder of its range have notably declined (Connelly and Braun 1997, Braun 1998, Connelly et al. 2004). Conservative estimates suggest that only 56% of the pre-European settlement area occupied by greater sage-grouse is still occupied or capable of supporting the species on an annual basis



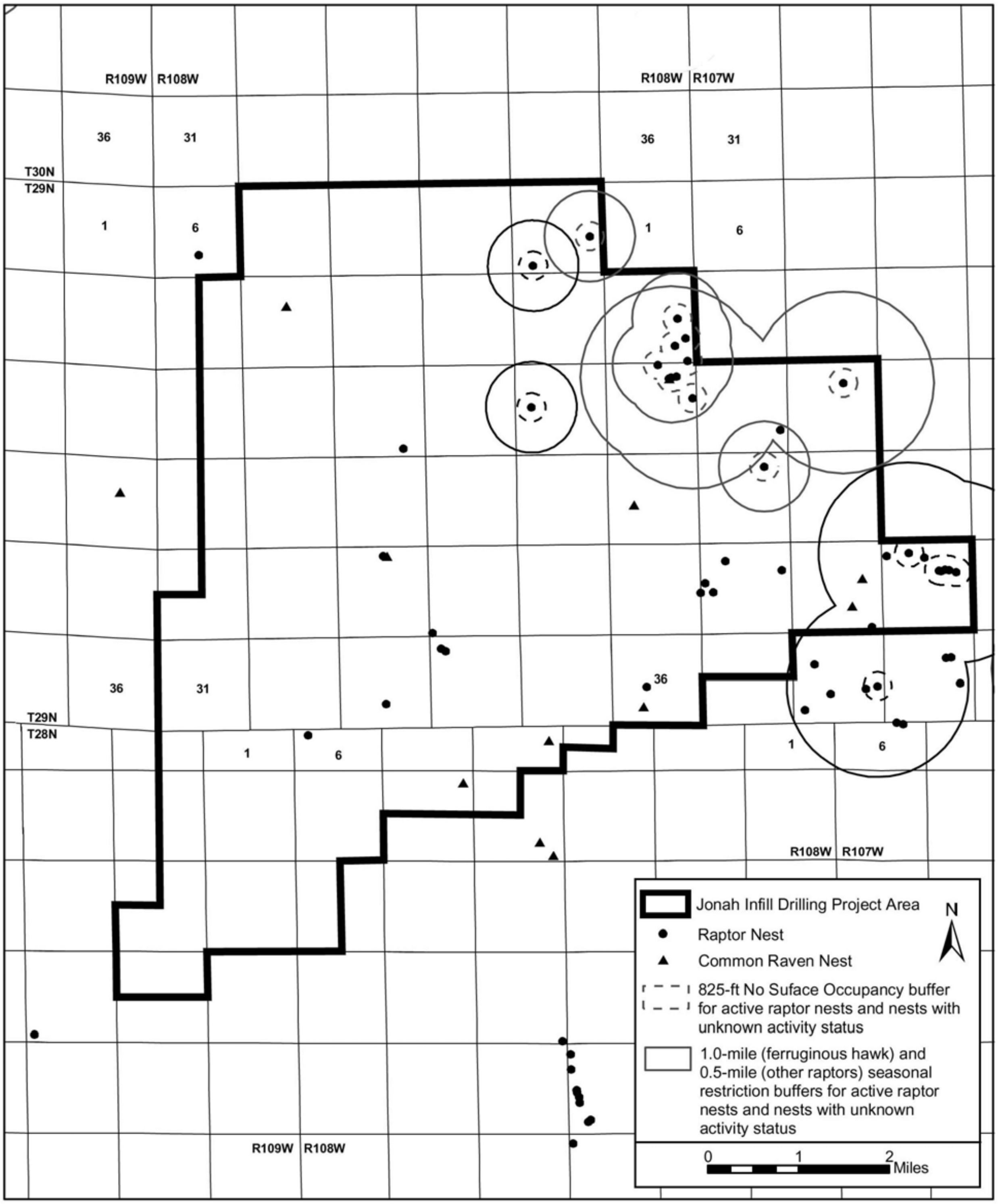
Source: BLM (Based on data from TRC Mariah, 2004)

Map 3.15. Prairie Dog Colonies, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



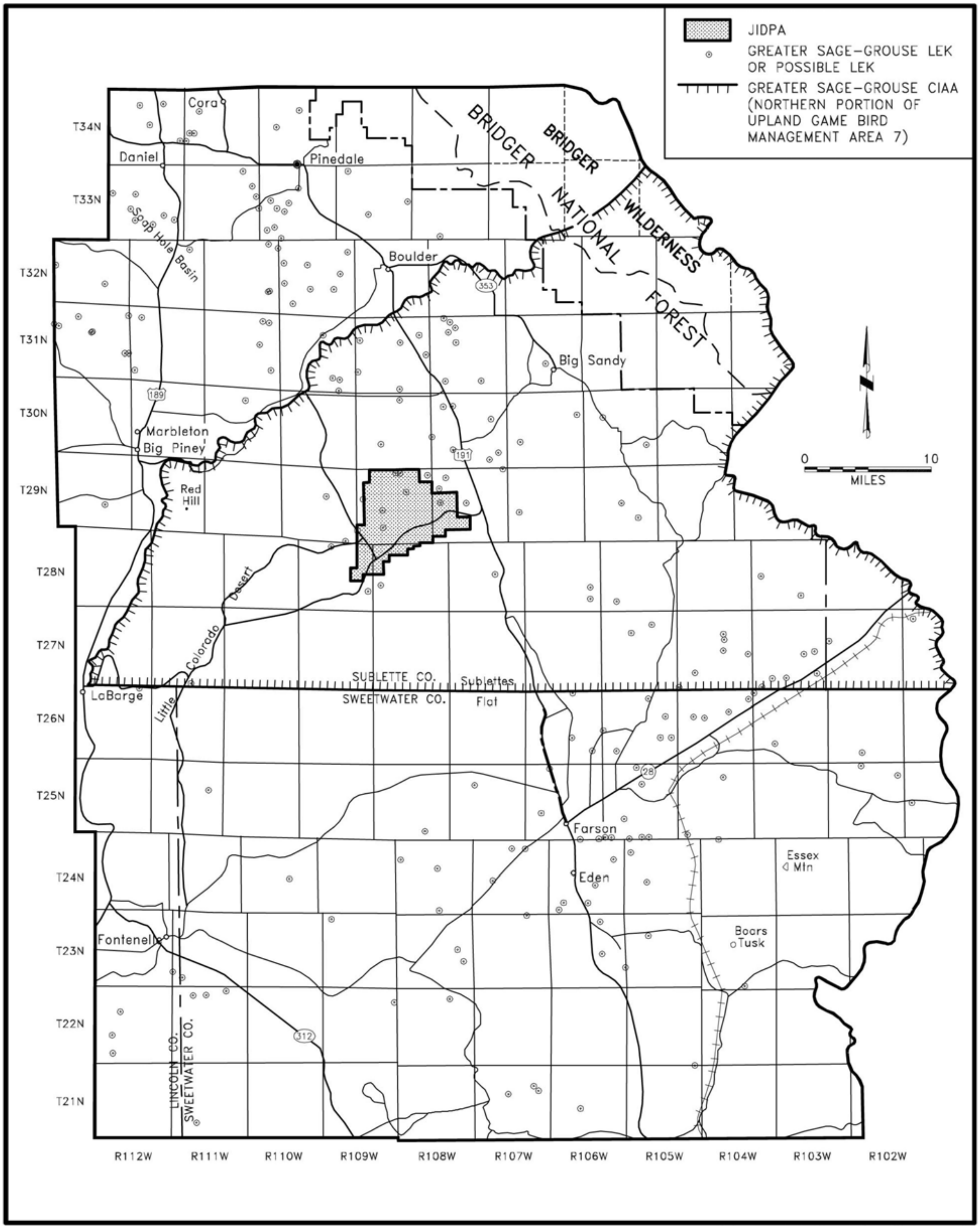
Source: BLM

Map 3.16. Raptor Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



Source (Based on data from TRC Mariah, 2004)

Map 3.17. Raptor Nests on or Adjacent to the Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



Source: BLM

Map 3.18. Greater Sage-grouse Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

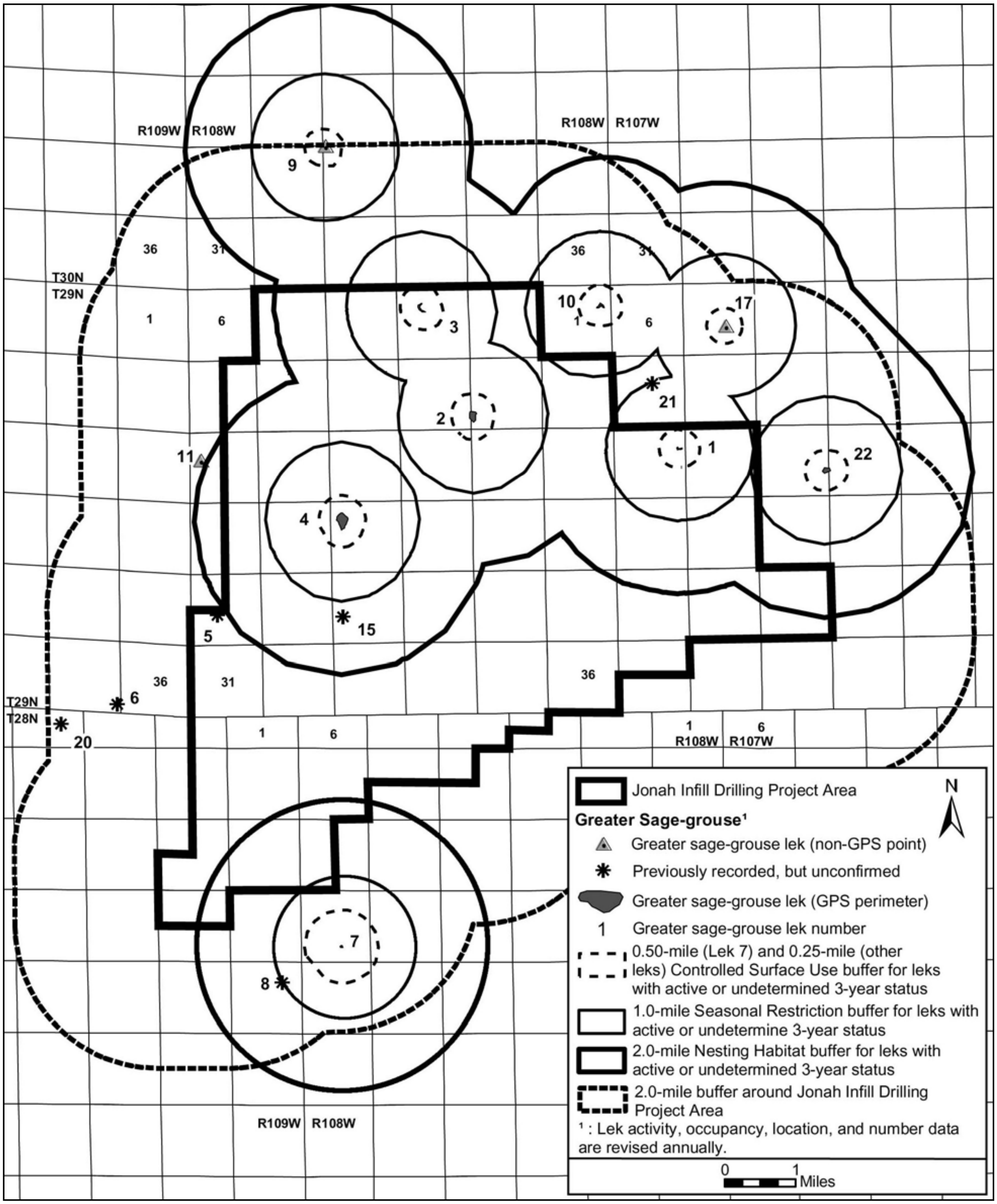
(Braun et al. 1976, Braun 1995, Connelly et al. 2004). Eleven of 13 states have shown significant declines. Historically, Wyoming supported more greater sage-grouse than any other state due to the presence of extensive sagebrush habitats (Patterson 1952). The areas in central and western Wyoming, where sagebrush-dominated landscapes and greater sage-grouse populations remain relatively contiguous and intact, cumulatively represent one of the species' last strongholds (Braun 1998). The number of male sage-grouse counted per lek in Wyoming decreased 17% between 1985 and 1995 (Connelly and Braun 1997), and regional declines as high as 73% between 1988 and 1999 have been recorded. The average decline in male attendance on leks in Wyoming from 1965–2003 is 49% and lek size has also significantly decreased (Connelly et al. 2004). Changes in the sagebrush-dominated areas where birds typically reside are thought to be one of the principal reasons for population declines (Braun 1998). These changes have resulted from fire, plant invasions, land conversions, urbanization, livestock grazing, energy development, noise, and other factors.

Greater sage-grouse lek monitoring is conducted annually on the JIDPA and surrounding areas. The WGFD, BLM, University of Wyoming Cooperative Fish and Wildlife Research Unit, and TRC Mariah are responsible for the lek activity status monitoring in the area (TRC Mariah 2004a). Ten active leks have been identified on or within a 2-mile buffer of the JIDPA (Map 3.19 and Table 3.19). In addition, six formerly identified leks occur in the area; however, these areas are no longer classified as leks (see Table 3.19). Data from the JIDPA and for the entire Upper Green River Basin show declines in male greater sage-grouse attendance at leks. Additionally, declines appear to be occurring at a faster rate in areas with oil and gas development (WGFD unpublished data; Clause pers. comm.). Declines in lek attendance likely indicate a reduction in the regional population.

Site-specific surveys of the JIDPA conducted over the last few years indicate that while the area is still used for nesting and summer and winter foraging, use of the area by greater sage-grouse continues to decline. This decline is likely due in part to the increased loss of habitat resulting from oil and gas development. Habitat conditions in the JIDPA are described in Section 3.2.1.

To maintain or move PFO greater sage-grouse habitat toward RMP goals, existing PFO area-wide and statewide stipulations on leases and COAs on APDs and ROWs apply a Controlled Surface Use restriction within 0.25 mile of an occupied lek. There are also timing stipulations protecting breeding activities, nesting and brood-rearing females, and wintering grouse, but these stipulations do not preclude exploration and development from occurring in nesting and wintering habitat outside of the timing restriction dates, and therefore, habitat is not protected from development. Given the noted decline in greater sage-grouse use of the JIDPA, existing protection measures within the JIDPA appear to be inadequate.

Sand Draw and adjacent areas have been identified as containing important greater sage-grouse habitat (particularly for nesting and wintering); therefore, past BLM decisions for the Jonah Field identified specific measures for the protection of this drainage (BLM 1998b, 2000b). These measures include no well construction within 300 feet of the edge of Sand Draw and the basin big sagebrush-dominated areas associated with this drainage channel. Roads and pipelines that must cross these draws would be constructed perpendicular to drainage channels, and engineering designs would specifically address each road/pipeline crossing in an effort to minimize disturbance.



Source (Based on data from TRC Mariah, 2004)

Map 3.19. Greater Sage-grouse Leks, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

Table 3.19. Greater Sage-Grouse Lek Attendance Trends, Jonah Infill Drilling Project, Sublette County, Wyoming, 1992–2004[1]

Lek No.[2]	Most Recent Activity	History[3]												
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	2004	NS	NS	9	NS	26	6	31	25	22	12	10	14	13
2	2004	NS	NS	2	NS	2	17	12	7	14	16	NS	6	7
3[4]	2004	NS	NS	NS	NS	16	0?	36	26	22	27	17	23	15
4	2003	NS	NS	16	NS	15	4	4	0	1	1	0	1	0
5[5]	1996[6]	NS	NS	NS	NS	1	0?	0	0	NS	NS	NS	0	NS
6[5]	1996[6]	NS	NS	NS	NS	3	0?	0	0	0	NS	NS	0	0
7	2004	NS	NS	36	NS	0	16	17	11	9	6	NS	3+	2
8[5]	1996[6]	NS	NS	NS	NS	2	0?	0	0?	0	NS	0	0	0?
9	2004	NS	NS	NS	NS	NS	-50	26	62	47	45	46	36	13
10	2004	NS	NS	NS	NS	NS	60	53	79	64	62	47	25	16
11[5]	UNK	NS	NS	UNK	NS	UNK	NS	0	0	0	NS	NS	0	0?
15[5]	1996[6]	NS	NS	NS	NS	1	0?	0	0	0	NS	NS	0	0
17	2001[6]	NS	NS	NS	NS	NS	NS	NS	5	3	3	0	0?	0
20[5]	UNK	NS	NS	0	NS	0	NS	NS	NS	NS	NS	NS	0	0
21[5]	2000[6]	NS	NS	NS	NS	NS	NS	NS	NS	10	NS	NS	NL	0
22	2000	NS	NS	NS	NS	NS	NS	NS	NS	9	0	0	0	0

1 Further detail is provided in TRC Mariah 2004a.
2 See Map 3.19 for locations; lek numbering is consistent with TRC Mariah 2004a.
3 Numbers refer to maximum male attendance observed; NS = not surveyed; NL = not located—survey was attempted but no birds were observed and exact location of lek could not be confirmed; UNK = unknown; + = unclassified birds observed but not included; ? = no males were observed on the lek, but the lek was visited less than three times during that breeding season.
4 This lek/lek location may be revised to accommodate two leks.
5 WGFD in consultation with BLM has removed these locations from consideration as leks because they may never have met WGFD lek criteria and/or they may represent areas where birds were observed after departure from an established lek.
6 The lek may have been active more recently than indicated because data are lacking for at least 1 year since the last known activity.

Greater sage-grouse breeding habitats are sagebrush-dominated rangelands, typically consisting of large, relatively contiguous sagebrush stands, which are critical for the survival of greater sage-grouse populations (Connelly et al. 2000). Because grouse populations typically inhabit large interconnected expanses of sagebrush, they have been characterized as a landscape-scale species (Patterson 1952, Wakkinen 1990). Therefore, conserving landscapes with suitable winter habitat also may be important for species conservation (Eng and Schladweiler 1972). Total shrub canopy cover, residual grass cover, non-food forb cover, and litter cover are the best predictors of greater sage-grouse nesting habitat (Holloran 1999, Lyon 2000). Typically, greater sage-grouse nests are located in habitat with >20% sagebrush canopy cover (Holloran 1999, Lyon 2000). Braun et al. (1976) indicated that most hens nest within 3.2 kilometers (2.0 miles) of a lek, but more recent studies suggest many hens nest further away. The average distance moved by hens from undisturbed leks to nests in western Wyoming was 2.1 kilometers (1.3 miles), whereas the average distance traveled from disturbed leks to nests was 4.1 kilometers (2.5 miles) (Lyon and Anderson 2003). Nest initiation rate was also higher for hens captured on undisturbed leks than those captured on disturbed leks (Lyon and Anderson 2003), and the presence of vehicle traffic appears to lower nest initiation rates. The chance of successfully hatching chicks (nest success) increases by 30% if there is at least 20% cover that includes both sagebrush and herbaceous vegetation and if the vegetation is at least 15 centimeters in height (Holloran 1999). Greater sage-grouse nest success ranges from 12% to 86% and is relatively low compared to other prairie grouse species (Connelly et al. 2000). While sage-grouse have used highly fragmented habitats in some oil fields and reclaimed areas, population levels in these areas are below pre-disturbance numbers (Connelly et al. 2004).

Important greater sage-grouse wintering habitat within the Jonah and Anticline Fields and surrounding areas currently is being identified by the BLM in cooperation with WGFD. Identification of sage-grouse wintering areas will be based, at least in part, on aerial winter sage-grouse surveys.

The other game bird likely to occur on the JIDPA is the mourning dove. The mourning dove is a common summer resident that prefers open land with scattered vegetation and requires trees or some other type of structure for nesting. Mourning doves that frequent the JIDPA likely utilize the shrub-covered areas along Sand Draw that provide suitable cover for nesting and roosting.

Other Birds

The CIAA for other birds is the same as that for general wildlife (see Map 3.14). Based on observations and range and habitat preferences (WGFD 1999; Dorn and Dorn 1999; TRC Mariah 2001a, 2001b, 2002, 2004a), other bird species known or likely to occur on the area include common raven, horned lark, lark bunting, loggerhead shrike, sage sparrow, sage thrasher, Brewer's sparrow, cliff swallow, barn swallow, mountain bluebird, western kingbird, grasshopper sparrow, killdeer, common nighthawk, black-billed magpie, American crow, canyon wren, western meadowlark, Brewer's blackbird, common grackle, and brown-headed cowbird. Several species of wading/shore birds and waterfowl also may occur around reservoirs. Wading/shore birds include black-necked stilt, willet, Wilson's phalarope, common snipe, great blue heron, snowy egret, long-billed dowitcher, and black-crowned night-heron. Waterfowl include pied-billed grebe, eared grebe, western grebe, green-winged teal, blue-winged teal, cinnamon teal, mallard, northern pintail, northern shoveler, gadwall, American wigeon, and ruddy duck.

3.2.2.3 Amphibians and Reptiles

The CIAA for amphibians and reptiles is the same as that for general wildlife (see Map 3.14). Based on range and habitat preferences (Baxter and Stone 1980), two amphibian and four reptile species are likely to occur on the JIDPA. Amphibians include the Great Basin spadefoot and northern leopard frog, and reptiles include the northern sagebrush lizard, eastern short-horned lizard, bullsnake, and wandering garter snake.

3.2.2.4 Fisheries

The fisheries CIAA is the combined area of project-affected watersheds (see Map 3.8). There are no perennial streams on the JIDPA, and no fish are known to occur in the area. The nearest perennial streams with significant fishery resources are the Big Sandy, New Fork, and Green Rivers (see Section 3.1.6.1 and Map 3.8). The Big Sandy River is approximately 5 miles east of the JIDPA, the New Fork River is approximately 7 miles northwest of the area, and the Green River is approximately 12 miles west of the area.

3.2.3 Threatened, Endangered, Proposed, and Candidate Species and BLM Wyoming Sensitive Species

The Endangered Species Act (ESA) (16 USC 1531–1543) protects listed threatened and endangered plant and animal (TEP&C) species and their critical habitats. To ensure compliance with the ESA, BLM prepared a Biological Assessment (BA) of potential impacts of the JIDP on federally listed species and submitted it to the USFWS on October 25, 2005, with a request for formal consultation. In a letter dated December 16, 2005, the USFWS agreed to initiate formal consultation on the potential effects of the JIDP (see Appendix H). The USFWS expects to issue a Biological Opinion in January 2006.

A list of TEP&C species that potentially occur on or in the vicinity of the JIDPA was compiled from several sources, including a written communication from the Wyoming State Supervisor's Office of the USFWS (USFWS 2003), the WyNDD, and information provided by the BLM PFO (Table 3.20). Seven federally listed TEP&C species potentially occur in the vicinity of the JIDPA or could otherwise be potentially affected by the proposed project: the black-footed ferret, bald eagle, four Colorado River endangered fish species (Colorado pikeminnow, humpback chub, razorback sucker, and bonytail chub), and one plant species (Ute ladies'-tresses).

3.2.3.1 Black-footed Ferret

Black-footed ferret, a federally endangered species (endangered species are those that are in danger of extinction throughout all or a significant portion of their range), was once distributed throughout the high plains of the Rocky Mountain and western Great Plains regions (Forrest et al. 1985). Prairie dogs are the main food of black-footed ferrets (Sheets et al. 1972), and few black-footed ferrets have been collected away from prairie dog towns (Forrest et al. 1985). The *Black-footed Ferret Survey Guidelines for Compliance with the Endangered Species Act* (USFWS 1989) defines potential black-footed ferret habitat as any white-tailed prairie dog towns or complexes greater than 200 acres in size with a burrow density greater than 20 active burrows per hectare (8 active burrows per acre). The USFWS Wyoming Field Office has block-cleared large portions of Wyoming for black-footed ferrets, including all lands within the JIDPA (USFWS 2004). USFWS considers block-cleared areas unlikely to be inhabited by black-footed ferrets, and surveys for ferrets in these areas are not required. However, block-clearance of an area "does not provide insight into an area's value for survival and recovery of the species through future reintroduction efforts"; thus, prairie dog towns in the JIDPA (see Map 3.15) may still provide important habitat for the species. Therefore, BLM continues to evaluate actions in these areas to determine if actions could adversely affect the value of prairie dog towns as future black-footed ferret reintroduction sites.

Table 3.20. Federal Threatened, Endangered, Proposed, and Candidate Species and their Potential Occurrence on the Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006

Species[1]		Federal Status[2]	Potential Occurrence on JIDPA[3]
Common Name	Scientific Name		
Mammals			
Black-footed ferret	*Mustela nigripes*	E	X
Birds [4]			
Bald eagle[5]	*Haliaeetus leucocephalus*	T	R
Fish			
Bonytail chub	*Gila elegans*	E	X
Colorado pikeminnow	*Ptychocheilus lucius*	E	X
Humpback chub	*Gila cypha*	E	X
Razorback sucker	*Xyrauchen texanus*	E	X
Plants			
Ute ladies'-tresses	*Spiranthes diluvialis*	T	X

1 List of species provided by USFWS (2003)., the WyNDD, and information provided by the BLM PFO.
2 Federal status:
E = Listed as federally endangered.
T = Listed as federally threatened.
3 Potential occurrence:
R = Rare; although the species may occur in the JIDPA while foraging, such occurrences are expected to be infrequent and of short duration based on recent field studies.
X = Unlikely; there has been no recent historical record of the species' occurrence in the JIDPA; probability of encountering the species during field development and operation is very unlikely.
4 The mountain plover was previously included as proposed for listing as federally threatened by the USFWS, but the decision not to list the species has since been published (*Federal Register*, September 9, 2003, 68[174]:53083–53101).
5 Proposed for removal from federal listing.

3.2.3.2 Bald Eagle

Protection for bald eagles was initially provided through the passage of the Bald Eagle Protection Act of 1940 (16 USC 668–668dd) and the Migratory Bird Treaty Act (16 USC 701–715). In 1973, the bald eagle was listed as endangered under the ESA (43 CFR 6233).

Bald eagle population estimates have increased in Wyoming since the species was listed as endangered. This increase is due, in part, to population growth, to significant reduction of environmental contaminants, and to the initiation of more intensive nesting surveys (Greater Yellowstone Winter Wildlife Working Group 1999). On July 12, 1995, a final rule to downlist the bald eagle from endangered to threatened in the lower 48 states was published in the *Federal Register* and on July 6, 1999, the USFWS proposed delisting the bald eagle.

The JIDPA is outside of any major bald eagle nesting or roosting areas. Bald eagles generally require cliffs, large trees, or sheltered canyons associated with concentrated food sources (e.g., fisheries or waterfowl concentration areas) for nesting and/or roosting areas (Edwards 1969, Snow 1973, Call 1978, Steenhof 1978, Peterson 1986). Bald eagle winter habitat generally is associated with areas of open water where fish and/or waterfowl congregate (Stahlmaster 1987, Greater Yellowstone Winter Wildlife Working Group 1999). Wintering bald eagles frequent unfrozen portions of lakes and free-flowing rivers and may occupy upland areas where ungulate carrion, game birds, and lagomorphs (rabbits and hares) are available (Swenson et al. 1986). Additionally, bald eagles forage over wide areas during the non-nesting season (i.e., fall and winter) and scavenge on animal carcasses such as pronghorn, deer, and elk; they may therefore potentially forage in the JIDPA.

No bald eagle nests or winter roosts are known to occur in the JIDPA, and the lack of suitable nesting areas or winter roosting habitats within the JIDPA precludes such activities by bald eagles. Fourteen bald eagle sightings (10 adults, two juveniles, and two unclassified) have been recorded within and adjacent to the JIDPA (WGFD 1996), although no bald eagles have been documented in the area since 1984. A WyNDD search revealed no records of bald eagle in the vicinity of the JIDPA (WyNDD 2003), and they have not been observed during annual wildlife investigations conducted on the JIDPA and surrounding wildlife study area (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). Bald eagles are known to nest and roost along the New Fork and Green Rivers north of the JIDPA (TRC Mariah 2003c), and they also have been observed in the Farson-Eden area south of the JIDPA (BLM 1994b).

3.2.3.3 Colorado River Endangered Fish Species

Four endangered Colorado River fish species (Colorado pikeminnow, razorback sucker, bonytail chub, and humpback chub) occur downstream from the JIDPA in the Green and Colorado Rivers. Water depletions from tributary waters within the Colorado River drainage may jeopardize the continued existence of these fish, and surface water or groundwater depletions in excess of 100 acre-ft per year require formal consultation with the USFWS (see Appendix H).

3.2.3.4 Ute Ladies'-Tresses

Ute ladies'-tresses is a perennial member of the orchid family that inhabits moist stream banks, wet meadows, and abandoned stream channels at elevations of 4,500–6,800 feet (Fertig 1994, Spackman et al. 1997). Where this plant occurs in ephemeral drainages, the soil typically is saturated within approximately 18 inches of the ground surface (USFWS 1992). Based on elevational range and lack of suitable habitat within the JIDPA, Ute ladies'-tresses is unlikely to occur in the area.

3.2.3.5 BLM Wyoming Sensitive Species

The BLM PFO identified 28 BWS animal and 25 BWS plant species that may occur in the JIDPA. These species and their preferred habitats are listed in Table 3.21. Management efforts for these species primarily involve habitat maintenance.

Based on field studies at JIDPA, a total of 12 BWS species (three mammals and nine birds) were recorded in the project area (see Table 3.21). BWS animal species recorded recently in the JIDPA include Idaho pocket gopher, white-tailed prairie dog, pygmy rabbit, Brewer's sparrow, sage sparrow, loggerhead shrike, long-billed curlew, mountain plover, greater sage-grouse, sage thrasher, burrowing owl, and ferruginous hawk (WyNDD 2003, TRC Mariah 2004a). Additional BWS animal species may occur in the project area, but such occurrences would likely be of foraging (e.g., long-eared myotis) or dispersing (e.g., peregrine falcon) individuals given the absence of suitable breeding/wintering habitats in the project area.

Table 3.21. BLM Pinedale Field Office Sensitive Animal and Plant Species and Potential Occurrence in the Jonah Infill Drilling Project Area, Sublette County, Wyoming, 2006[1]

Common Name	Habitat Preference[2]	Recorded Occurrence[3]
Mammals		
Long-eared myotis	Conifer and deciduous forests, caves, and mines	
White-tailed prairie dog	Basin-prairie shrub, grasslands	X
Idaho pocket gopher	Shallow stony soils	X
Pygmy rabbit	Basin-prairie and riparian shrub	X
Birds		
White-faced ibis	Marshes, wet meadows	
Trumpeter swan	Lakes, ponds, rivers	
Northern goshawk	Conifer and deciduous forests	
Ferruginous hawk	Basin-prairie shrub, grassland, rock outcrops	X
Peregrine falcon	Tall cliffs	
Greater sage-grouse	Basin-prairie shrub, mountain-foothill shrub	X
Long-billed curlew	Grasslands, plains, foothills, wet meadows	X
Mountain plover	Cushionplant communities; low sparse vegetation	X
Yellow-billed cuckoo	Open woodlands, streamside willow and alder groves	
Burrowing owl	Grasslands, basin-prairie shrub	X
Sage thrasher	Basin-prairie shrub, mountain-foothill shrub	X
Loggerhead shrike	Basin-prairie shrub, mountain-foothill shrub	X
Brewer's sparrow	Basin-prairie shrub	X
Sage sparrow	Basin-prairie shrub, mountain-foothill shrub	X
Fish		
Roundtail chub	Colorado River drainage, mostly large rivers, also streams and lakes	
Leatherside chub	Bear, Snake, and Green River drainages, clear cool streams and pools	
Bluehead sucker	Bear, Snake, and Green River drainages, all waters	
Flannelmouth sucker	Colorado River drainage, large rivers, streams, and lakes	
Yellowstone cutthroat trout	Yellowstone drainage, small mountain streams, and large rivers	
Colorado River cutthroat trout	Colorado River drainage, clear mountain streams	
Fine-spotted Snake River cutthroat trout	Snake River drainage, clear fast water	
Amphibians		
Northern leopard frog	Beaver ponds, permanent water in plains and foothills	
Boreal toad (Northern Rocky Mountain population)	Pond margins, wet meadows, riparian areas	
Spotted frog	Ponds, sloughs, small streams	

Table 3.21. (Continued)

Common Name	Habitat Preference[2]	Recorded Occurrence[3]
Plants		
Pink agoseris	Mountain meadows	
Meadow pussytoes	Subirrigated meadows within broad stream channels	
Soft aster	Mountain parks and meadows	
Meadow milkvetch	Moist alkali meadows and swales in sagebrush valleys, 4,400–6,300 ft in elevation	
Bastard draba milkvetch	Rocky areas with low cover within sagebrush and cushionplant communities on sandstone, stony clay, badlands, and barren clay slopes and ridges, 6,900–7,200 ft in elevation	X
Payson's astragalus	Clear cuts, burns, and blow-down areas in the Wyoming Range, 6,700–9,600 ft in elevation	
Trelease's milkvetch	Sparsely vegetated sagebrush communities on shale or limestone outcrops and barren clay slopes at 6,500–8,200 ft in elevation	X
Seaside sedge	Alpine and subalpine meadows	
Black and purple sedge (F)	High mountain slopes and meadows	
Cedar Rim thistle	Barren, chalky hills, gravelly slopes, and fine textured, sandy-shaley draws, 6,700–7,200 ft in elevation	X
Boreal draba	Volcanic slopes; cliffs and riparian areas with loamy alluvium, and mossy mats, 6,200–8,550 ft in elevation	
Rockcress draba	Rocky ridges and slopes in mountains	
Giant helleborine	Wet areas in Grand Teton and Yellowstone Parks	
Wooly fleabane	Talus steep alpine slopes or rims, 10,800–11,000 ft in elevation	
Narrowleaf goldenweed	Semi-barren clay flats and slopes, gravel bars and sandy lake shores, northwest and central Wyoming	
Keeled bladderpod	Sparsely vegetated outcrops on slopes and ridge crests, Teton County	
Large-fruited bladderpod	Gypsum-clay hills and benches, clay flats, and barren hills, 6,800–7,700 ft in elevation	X
Payson's bladderpod	Windswept gravelly ridge crests, semi-open slopes, and talus slopes in mountain sagebrush/grassland communities and conifer clearings, 5,500–10,600 ft in elevation	
Marsh muhly	Bogs, springs, peaty or calcareous meadows, floating mats, and stream edges, 4,700–6,600 ft in elevation	
Contracted Indian ricegrass	Plains and hills, basin areas, northwest-central, northeast, east-central, southwest and south-central Wyoming	
Naked-stemmed parrya	Steep talus slopes in alpine or upper subalpine zones, 9,600–12,240 ft in elevation	
Beaver Rim phlox	Sparsely vegetated slopes, Wind River Basin, Fremont County, 6,000–7,400 ft in elevation	
Tufted twinpod	Sparsely vegetated shale slopes and ridges 6,500–7,000 ft in elevation	X

Table 3.21. (Continued)

Common Name	Habitat Preference[2]	Recorded Occurrence[3]
Creeping twinpod	Barren, rocky, calcareous hills and slopes in mountainous areas, 6,500–8,600 ft in elevation	
Greenland primrose	Wet meadows and calcareous montane bogs, 6,600–8,000 ft in elevation	

1 Based on BLM (2003b).
2 Plant habitat preference based on Hallsten et al. (1987), Dorn (1992), and Keinath et al. (2003).
3 Recorded occurrences on or in the vicinity of the JIDPA (WYNDD 2003; TRC Mariah 2001a, 2001b, 2002, 2004a).

Based on a review of habitat preferences and known geographic locations (Hallsten et al. 1987, Dorn 1992), it was determined that the majority of BWS plant species listed in Table 3.21 have no or little potential for occurring in the vicinity of the JIDPA. Five of the 25 species—bastard draba milkvetch, Trelease's milkvetch, Cedar Rim thistle, large-fruited bladderpod, and tufted twinpod—have been recorded in the JIDPA during field studies (WyNDD 2003). The scattered/no sagebrush vegetation type (see Section 3.2.1.1 and Map 3.12) appears to provide the most important potential habitat for these species.

3.2.4 Wild Horses

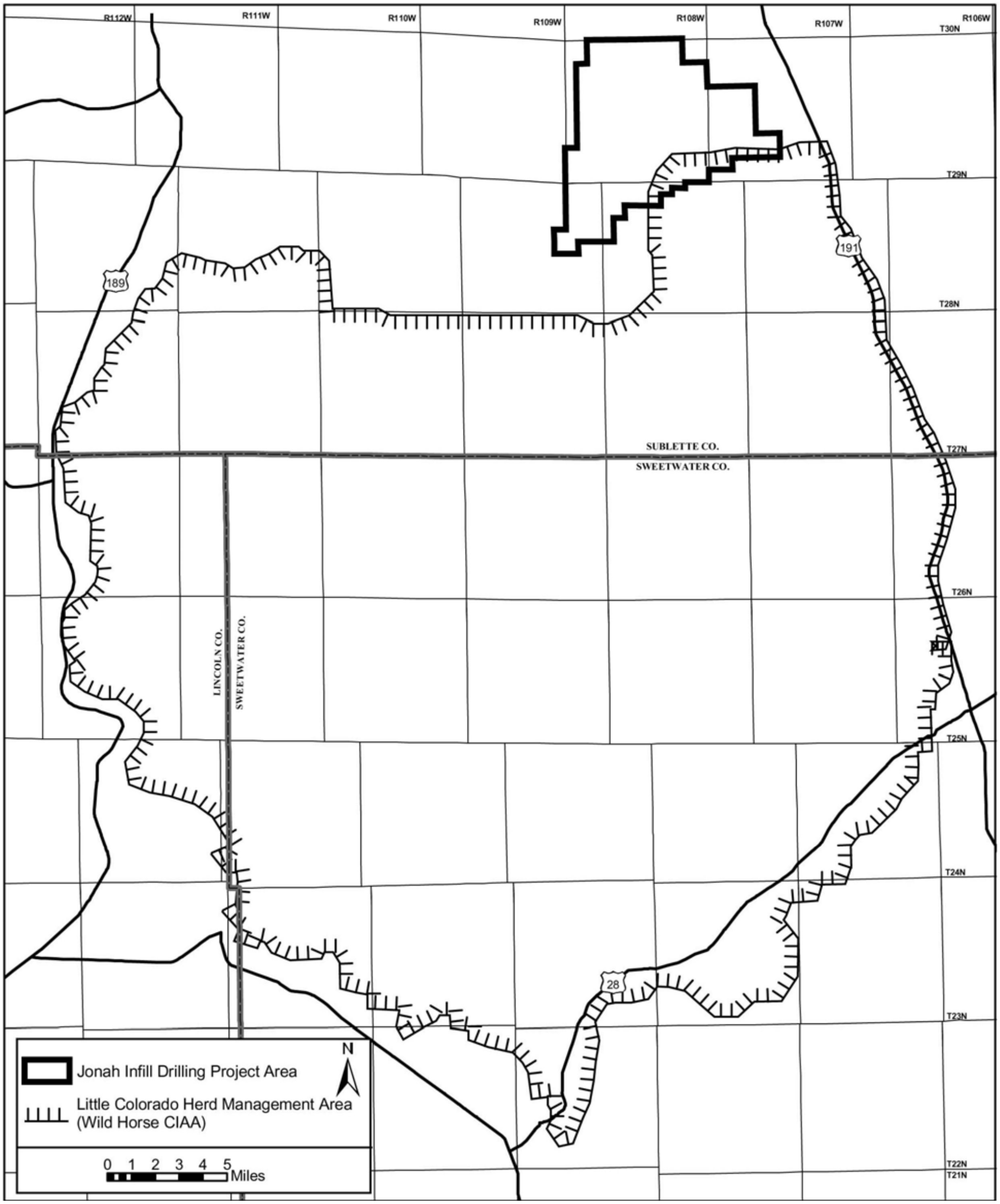
Spanish explorers originally introduced wild horses, also known as the American feral horses or mustangs, to the western United States. Over the years, wild horses have become a mix of numerous breeds that have escaped or been released by the U.S. cavalry, farmers, ranchers, and miners. That portion of the JIDPA contained in the RSFO area is included in the Little Colorado Herd Management Area (LCHMA) (Map 3.20). The LCHMA encompasses 519,541 acres (of which 6,310 acres [1.2%] are in the JIDPA). The estimated wild horse population was 240 in 2001; the appropriate management level (AML) for this herd area is 69 to 100 horses (BLM 2001). The entire LCHMA is the wild horse CIAA for this project. The portion of the JIDPA within the LCHMA does not receive a high level of wild horse use due to the limited availability of water. No managed wild horse herds occur in the PFO portion of the JIDPA and a fence separating the RSFO and the PFO areas restricts wild horse movement into the PFO area. However, horses from the LCHMA have entered the PFO area and the JIDPA (often through gates being left open), and are subsequently herded back to the RSFO and LCHMA.

3.3 CULTURAL AND HISTORICAL RESOURCES

The following sections discuss the cultural resources within the JIDPA. Cultural setting and an historic overview were provided in the Jonah II EIS (BLM 1997a, 1998a). Because this information is not fully repeated here, for immediate reference, the Jonah II Cultural Setting and Historic Overview has been included in the JIDPA FEIS Appendix I.

3.3.1 Introduction

Cultural resources, which are managed pursuant to the National Historic Preservation Act of 1966 (NHPA) and the Archaeological Resources Protection Act of 1979 (ARPA) and other statutes, are the nonrenewable remains of past human activity. The CIAA for cultural resources includes the



Source: BLM

Map 3.20. Little Colorado Wild Horse Herd Management Area (CIAA), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

JIDPA and surrounding area as depicted on Map 3.5. The cultural resource and archaeological record of the JIDPA has been identified and established through Class III cultural resource inventories (100% coverage pedestrian surveys), informal surveys, construction monitors, test excavations, salvage excavations, formal data recovery excavations, examination of ethnographic materials used to determine ethnic origin, local informant interviews, consultation with modern Native American people, archival sources, and the historic record. Continued development, accelerating in pace since 1997, has steadily increased the number of cultural resource inventories performed (estimated at approximately 1,500), and the number of known sites has increased accordingly (estimated at between 1,000 and 2,000 sites).

3.3.2 Site Types

Cultural resources are typically identified as tangible properties, which are generally defined within a range of site types. The JIDPA is rich in prehistoric archaeological sites, including several sites culturally sensitive to Native American peoples, but contains few historic period sites. An informal search of the SHPO cultural records database indicated that (as of November 2003) there are over 1,000 known cultural properties within the JIDPA, the majority of which are prehistoric archaeological sites. Extrapolating from the results of seismic inventories that have provided broad systematic survey coverage of the area, roughly one site per 17 acres occurs within the JIDPA (an average of 38 sites per section). Actual site density is probably even higher due to frequently encountered buried archaeological sites that lack surface manifestations.

A considerable amount of cultural resource inventory, and archaeological site testing, monitoring, and salvage or 'data recovery' excavation has been completed in the JIDPA, especially since the mid-1990s (estimated at over 1,500 actions). This work has resulted in the identification and recording of a large number of prehistoric cultural properties (estimated at over 1,000), most exceptionally including numerous subsurface archaeological sites discovered during construction. Larger-scale data recovery excavations are becoming more common as discoveries continue to be made and adverse effects are mitigated.

Significant historic period cultural resources have not yet been part of archaeological discoveries or needed mitigation. This is because the majority of historic sites in the JIDPA consist of nonsignificant debris scatters. No known significant or sensitive historic period sites occur in the JIDPA and past work in the area has indicated a low likelihood of historic site types. The historic period sites in the JIDPA predominately relate to open-range ranching, stock grazing, and wagon road passage. Regional Emigrant Trails, such as the Pre-territorial period Lander Trail, and Fur Trade period rendezvous grounds, as near Fort Bonneville, occur well outside of the JIPDA. The fact that the area is dominated by BLM administered lands is indicative of the area not receiving substantial historic habitation; those lands remaining in federal holding did not become homesteads. Only one historic standing building, a log cabin, is believed to be in the JIDPA, but is not currently a formally documented resource. In the historic era, area lands remained predominantly rangelands, primarily used for grazing. Nonsignificant recent and past range improvements occur in the area, such as stock ponds and dams.

Known prehistoric site types within or near the JIDPA are not as limited in number or range as historic site types. The spectrum of prehistoric site types includes open campsites, lithic scatters, housepits, rock alignments, kill/butchering sites, rockshelters, floral processing locales, sacred or respected sites, extensive lithic procurement locales (see Archaeological Landscapes, Appendix F-1.5 of the Jonah II EIS [BLM 1997a, 1998a]), limited activity sites, and Traditional Cultural Properties.

A "Traditional Cultural Property" generally can be defined as a property that is eligible for inclusion in the National Register of Historic Places (NRHP) because of its association with cultural practices or beliefs of a living community that are rooted in the community's history and are important in maintaining the continuing cultural identity of the community. The Traditional Cultural Properties in the JIDPA also are considered sacred or respected places (areas that local Native American tribes consider sensitive, important for current uses [e.g., plant collection], and/or of religious importance) pursuant to EO 13007. These properties include rock alignment sites, visionquest locales, stone circle sites such as tipi rings, and cairns. No drivelines are currently known, but they may be present in the area. No petroglyph or pictograph sites are presently known, even though the geology of the area (i.e., the presence of numerous rock outcrops) is conducive to the presence of these site types. One prehistoric human burial has been encountered. Prehistoric sites between 4,000 and 7,000 years old are common, many of which are completely buried with few (if any) surface manifestations.

3.3.3 Native American Sensitive Sites and Traditional Cultural Properties

In the late nineteenth century, the JIDPA was used predominantly by the Shoshone Tribe, though Bannock, Ute, and other tribes frequented the Upper Green River. Sites relating to prehistoric tribal use exist, but identifying specific tribal affiliation to these remains is difficult. Some prehistoric sites, as well as some of the more recent Native American use sites, may be considered respected areas or sensitive sites by modern Native Americans and may be formally considered Traditional Cultural Properties.

Sites and properties within this class are protected by numerous laws, such as the Native American Graves Protection and Repatriation Act (NAGPRA), the American Indian Religious Freedom Act (AIRFA), and by various executive orders (e.g., EO 13007). Human burials, rock alignment sites, petroglyphs, steatite procurement locales, and modern-day Native American use, extraction, or religious sites are considered sensitive or sacred to modern Native Americans. Several such sites have been identified in the area. Consultation with potentially affected Native American Tribes concerning the identification and management of specific Traditional Cultural Properties and other sensitive sites began in 1998, and this consultation resulted in several recommendations concerning the management of sensitive/sacred/respected sites, disturbance buffers, holistic management approaches and guidelines, and how Native American traditional practitioners want BLM to manage sensitive areas. The general theme of the consultation has been to leave these sensitive areas undisturbed.

Representatives of the Shoshone and Ute Tribes have visited the Jonah area during the period of 1997 through 2001. Consultation particularly focused on the Site 48SU4000 Archaeological District. Additionally, in 2002, formal NAGPRA consultation with the Shoshone Business Council took place concerning the 7,300-year-old human remains encountered during construction of a well pad. The last consultation took place between the BLM and the Shoshone in October 2005 in support of the Jonah "Bullseye" seismic project. Consultation between the BLM, Shoshone Tribe, and possibly other tribes would continue throughout project development.

3.3.4 Culture History Context and Chronology

The general cultural setting and historic overview for the Jonah Field appear in Appendix I. Due to a paucity of significant historic site types in the area, a historic overview will not be reiterated here, and Appendix I should be specifically referred to in reference to the region's historic period context, chronology, and themes. A prehistoric cultural setting is also presented generally in Appendix I; however, those portions of context relevant to known and potential significant cultural properties in the JIDPA are specifically represented here.

The prehistory of the Green River Basin, which encompasses the JIDPA, is typically considered in relationship to the prehistory of the larger western Wyoming Basin, which also includes the Great Divide and Washakie Basins and the Rock Springs and Rawlins Uplifts. The prehistory of the western Wyoming Basin is typically discussed in terms of a series of periods and phases originally defined specifically for the region by Metcalf (1987) (Table 3.22). The breakdown of periods and phases is based on such characteristics as artifact assemblages, house and pit forms, shifts in settlement or resource procurement patterns, and peaks and valleys in the frequencies of radiocarbon dates (Wheeler et al. 1986, Metcalf 1987, McNees et al. 1992, Thompson and Pastor 1995, Vlcek 1997a). At the broader level, the prehistory of the region is broken down into the Paleoindian, Early Archaic, Late Archaic, Late Prehistoric, and Protohistoric periods. The Early Archaic, Late Archaic, and Late Prehistoric periods are typically further subdivided into the Great Divide and Opal phases, the Pine Spring and Deadman Wash phases, and the Uinta and Firehole phases, respectively. Although most researchers agree on the general nature and sequence of the phases, some disagreement exists on their beginning and ending dates. Table 3.22 uses the dating modified from McNees et al. (1992) and Vlcek (1997a).

Evidence indicates that the JIDPA has been occupied almost continuously since at least the Folsom stage of the Paleoindian period about 10,900 years before present (B.P.). Occupation of the area apparently intensified after approximately 8,500 years B.P. and especially after 7,200 years B.P.

Table 3.22. Prehistoric Cultural Chronology for the JIDPA and Southwestern Wyoming[1]

Period	Phase	Age (Years Before Present [B.P.])
Paleoindian	–	11,500–8,500
Early Archaic	Great Divide	8,500–6,000
	Opal	6,000–3,600
Late Archaic	Pine Spring	3,600–2,900
	Deadman Wash	2,900–1,800
Late Prehistoric	Uinta	1,800–1,000
	Firehole	1,000–250
Protohistoric	–	250–0

[1] Metcalf 1987; McNees et al. 1992; Vlcek 1997.

The Paleoindian period in Wyoming is typically discussed in terms of the sequence of "classic" Paleoindian point types initially established on the basis of data from the Hell Gap site in eastern Wyoming and subsequently amplified and refined. In the Wyoming Basin, it is typically represented by the Clovis, Goshen, Folsom, Agate Basin, and Hell Gap points. Alberta, Alberta-Cody, and Cody cultural complexes are also commonly represented but appear to be more transitional to the lifeways represented in the subsequent Archaic period. The Paleoindian period was characterized by a large-animal hunting-oriented economy that was specialized even in contrast to later bison-hunting groups on the plains. Initially, that strategy focused on the procurement of mammoth and/or other megafauna, but then it shifted to bison and apparently incorporated an increasingly broader spectrum of smaller animal and plant resources.

Occasional surface finds of fluted projectile points of the Clovis and Folsom traditions indicate that, at a minimum, human beings have lived in the Green River Basin since the end of the Pleistocene geologic epoch. However, evidence of the big game foraging tradition, which has defined the early Paleoindian adaptation, is rare. Evidence most commonly consists of surface finds of Paleoindian points.

Few sites containing classic Paleoindian points have been discovered in the area, although such sites are known. For example, the site complex containing Sites 48SU389, 48SU907, 48SU908, and 48SU909 just south of the JIDPA has produced artifacts from the Folsom, Hell Gap, Agate Basin, Scottsbluff, and Cody complexes spanning a time period from 12,000 to 8,000 years B.P. (Frison 1991). Folsom points have been found at three localities in the JIDPA (two along Sand Draw and one in the 48SU4000 Archaeological District). At least 16 sites or locations have produced surface Paleoindian projectile points in the Jonah area. Site 48SU1421, situated adjacent to an ancient playa, contained several projectile points that tentatively date two components at the site from 9,000 to 8,500 years B.P. Another site (Site 48SU2980) encountered during pipeline construction has been dated to 8,600 years B.P. and has a possible Paleoindian connection, and sites/site complexes that include Sites 48SU2662, 48SU3087, and 48SU3090 have also produced Paleoindian material. A Hell Gap point was discovered eroding out of a low sand sheet in the northern Jonah Field, and Scottsbluff complex artifacts have been recorded in various portions of the field, including within the Site 48SU4000 Archaeological District (see Section 3.3.7). Additionally, three Early Archaic period JIDPA sites (48SU2094, 48SU2324, and 48SU4479) dating from 4,590 to 8,210 years B.P. were recently excavated (McKern and Harrell 2004).

The lifeways defining the Early Archaic period in the western Wyoming Basin may have begun as early as the middle Paleoindian period, possibly as a result of a "settling-in" process (McNees 1998:36). These lifeways apparently were characterized by the more-intensive use of the landscape by groups pursuing an increasingly broad-spectrum hunting and gathering lifestyle. Specific characteristics of those lifeways are believed to have included a settlement and subsistence strategy oriented to specific geographic areas on a year-round basis, including especially a reliance on a broader range of plant and animal food resources. This more "place-oriented" lifeway resulted in the apparent elaboration of house and cooking pit forms represented in the archaeological record.

In the western Wyoming Basin in general, the archaeological record contains a gradually increasing number of dated components through the time period beginning around 8,500 years B.P., with a more significant increase after 6,000 years B.P. Then the number of radiocarbon-dated sites generally declines again across the region throughout the Late Archaic period. Cultural remains dating to the Late Archaic period become more complex and more diverse through time. The earlier part of the Early Archaic period corresponding to the Great Divide phase is typically characterized by sites containing limited remains, typically a simple firepit or two, a few flaked stone artifacts, and bone scraps, most commonly from rabbits and occasionally pronghorn. Artifacts associated with Early Archaic period sites in the area tend to be limited in number and type. The Great Divide phase is typically characterized by large side-notched points, giving way to more-diverse, less-distinctive, and less-frequent collections of side- and corner-notched projectile points of the Opal phase. After about 6,500 years B.P., housepits become a prominent trait of the period, as do slab-lined cylindrical baking pits and deep unlined baking pits after about 6,000 years B.P. The coalescence of those traits is judged to represent the transition to the Opal phase around 6,500 to 6,000 years B.P. The Opal phase appears to have been a time of a significant increase in the number of sites and population compared with the preceding and subsequent phases in the western Wyoming Basin in general (Smith 2003). Small mammals, especially rabbits probably opportunistically captured near the camps, are the most commonly identified animals from the housepit bone assemblages. However, pronghorn bone is also relatively common, and the Trapper's Point site to the north of the JIDPA evidences relatively intensive pronghorn procurement. The deep baking pits suggest the relatively widespread use of roots, most likely biscuitroot and onion.

One of the most distinctive aspects of the archaeological record of the JIDPA and its immediate surroundings is the abundance of archaeological sites dating to the later Great Divide phase, in contrast to the rest of the western Wyoming Basin (TRC Mariah 2001c). The archaeological record indicates that occupation of the JIDPA began to intensify after approximately 8,500 years B.P. as elsewhere in the region. However, the major increase in occupation apparently began around 7,200 years B.P. The appearance of the remains of house structures in and around the JIDPA likewise pre-dates that in the rest of the region. Figure 3.14 illustrates the excavation of a typical housepit. Most of the houses have yielded radiocarbon dates between 7,110 and 6,000 years B.P. A post mold associated with a house at Site 48SU3835 yielded an age estimate of 8,240 years B.P. (Nelson and Richard 2004) and one associated with a house at the J. David Love site (Site 48SU4479) yielded an age estimate of 8,210 years B.P. (McKern and Current 2004), the two earliest dates for house structures recorded in the region. Only a few structures in the project area have yielded dates of less than 6,000 years B.P. By contrast, only one housepit out of 41 fully excavated housepits from 21 sites in Wyoming listed by Smith (2003) and a list of excavated housepits from the Green River Basin and immediately adjacent areas compiled by Thompson and Pastor (1995) yielded a date of 6,000 years B.P. or older, and it was dated at 6,000 years B.P. Therefore, it is clear that the house remains in the Jonah area represent a distinctive temporal phenomenon in the archaeological record of the region.

The house structures excavated in the JIDPA are distinctive in other ways as well. They include both "classic" housepits characterized by large, circular stains that are basin-shaped in cross section, as well as circular or semicircular areas delineated by apparent post molds around the perimeter of clusters of hearth-type basins. The latter type appears to be distinctive to the Jonah area.

The transition from the Early Archaic period to the Late Archaic period is marked by a decrease in radiocarbon-dated sites in the western Wyoming Basin at about 3,600 years B.P. Despite minor regional peaks from 3,200 to 3,000 years B.P., 2,900 to 2,700 years B.P., and 2,000 to 1,800 years B.P., the frequencies of radiocarbon-dated sites remain depressed into the early Late Prehistoric period. Because of the limited number of investigated sites dating to the Late Archaic period, it remains poorly understood. The period was apparently marked by the decreased use of the area by interior basin-adapted groups, possibly reflecting a decline in population and/or a shift in settlement and subsistence strategies (McNees 1992).

Some investigators in the region have placed the end of the Opal phase Early Archaic period and the start of the Pine Spring phase Late Archaic period around 4,400 years ago to coincide with the full time span of McKean complex dart points in the region. However, sites containing McKean complex points appear to represent a different cultural phenomenon than the abundance of sites displaying more typical Opal phase traits such as housepits, slab-lined cylindrical pits, deep baking pits, and side- and corner-notched projectile points. Only after the cultural complex exhibiting these latter traits becomes attenuated around 3,600 years B.P. do sites containing McKean complex points become dominant as a result of the vacuum created by the absence of the more typical Opal phase sites.

The Pine Spring phase of the Late Archaic period is typically defined by the prevalence of McKean complex dart points. McKean complex stemmed and lanceolate dart points occur at sites in the western Wyoming Basin beginning as early as 4,900 years B.P. (McNees 1992). They appear to be most common at sites dated between 4,400 and 3,000 years B.P. Surface finds of McKean complex dart points are common within and around the JIDPA. McKean complex points

Source: BLM

Figure 3.14. Typical Housepit Excavation, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

have been reported for Site 48SU1754 in the Bull Draw drainage, Site 48SU1328 on a bench above Sand Draw, and Site 48SU3090 at the Sand Draw playa complex. The McKean complex point at Site 48SU3090 is consistent with age estimates obtained from features in the complex, including estimates of 3,580 and 3,900 years B.P. from a cobble-lined and a bell-shaped basin, respectively, suggesting the presence of intact McKean complex components in the area (Plastino 1999). Based upon radiocarbon dating, a McKean concentration has been found in the JIDPA. The presence of Pine Spring phase sites in the JIDPA is also indicated by firepits radiocarbon-dated to that time period (Vlcek 1997b).

The transition from the Pine Spring phase to the Deadman Wash phase is typically placed around 3,000 or 2,900 years B.P. to correspond with the transition from the use of McKean complex dart points to the use of corner-notched dart points. Evidence for Deadman Wash phase use of the JIDPA is even more limited than for Pine Spring phase use. Corner-notched dart points diagnostic of the phase are not as distinctive or definitive as McKean complex points, making them less effective as an indicator of occupation of the area during that time period. Likewise, fewer features have been dated to this phase, which suggests that the phase may be poorly represented in the area.

The Uinta phase of the Late Prehistoric period exhibits a peak in the number of radiocarbon-dated components in the western Wyoming Basin, specifically between 1,500 and 1,000 years B.P. In many aspects, this phase of the Prehistoric period more closely resembles the Early Archaic period than the immediately preceding Late Archaic period or the subsequent Firehole phase. The Uinta phase is generally considered to coincide with the introduction or general adoption of bow and arrow technology. Pottery also first appears in the archaeological record of the region during this period, although it apparently only became an integral element of the indigenous inhabitants of the region after approximately 900 years B.P.

The Uinta phase is characterized by repeated occupation of the same site localities and the use of deep cylindrical basins, small circular habitation structures, more common ornamental artifacts (e.g., bone tubes and bone disks), and a broad spectrum of large and small animals and plant resources, including pronghorn, occasionally bison, and seeds from weedy annuals. Uinta phase sites and components are often much more artifact- and data-rich than sites from other periods. Classic Uinta phase sites contain Rose Spring arrow points but lack pottery. Interestingly, radiocarbon-dated Uinta phase sites or sites with Rose Spring points are relatively uncommon in the JIDPA, though they do tend to cluster in the eolian sediments deposited along the northwestern edge of Yellow Point Ridge.

Following the Uinta phase is the Firehole phase. In most of the western Wyoming Basin, Firehole phase sites are rare in comparison to Uinta phase sites. McNees (1992) argues the Firehole phase represents a return to a lifeway that relied more heavily on hunting large game animals, including bison, similar to that of the Pine Spring and Deadman Wash phases, with less reliance on more intensive use of smaller animals and plants. The Firehole phase is characterized by the predominance of side-notched, tri-notched, and unnotched points; by quartz sand-tempered (Intermountain Ware) pottery; and by the abrupt disappearance of typical Uinta phase traits between 1,000 and 950 years B.P. Historic Shoshone cultural lifeways of the region seem to first become distinguishable during the Firehole phase.

In contrast to much of the western Wyoming Basin, the JIDPA and surrounding area contain a large number of sites dating to the Firehole phase. Site 48SU4000 Archaeological District appears to be dominated by Firehole phase materials (Miner 2001). The phase is associated with an extensive and distinct area of interior basin sandstone outcrops and includes numerous rockshelter alcoves and stone circles. Associated artifacts include side-notched and unnotched points and ceramics from five distinct localities. Ceramics recovered from 48SU4000 have been subject to thin sectioning analysis, and local manufacture is indicated. These ceramics show similarities to those found at the Wardell Buffalo Trap (Frison 1993). This ceramic assemblage (two sites with 500 sherds each) represents the highest known concentration of prehistoric ceramics anywhere in southwestern Wyoming. Ceramics have also been recovered from other sites in the area, including Sites 48SU1443, 48SU2261, and 48SU3017.

3.3.5 Geomorphology

Geomorphological studies that examine the relationship among geology, soils, topography, and vegetation are important to archaeologists because most significant prehistoric sites are located within specific soil matrices (i.e., the history of which contributes to the integrity of the site, the integrity of cultural deposits, and the post-depositional history of the site). These factors are critical for understanding the nature, integrity, and preservation potential of the archeological resources in the JIDPA.

Of particular interest in the JIDPA is the San Arcacio-Saguache soils complex (soil map unit 125), which occurs along the lower and middle reaches of Sand Draw. The San Arcacio soils form on geomorphically stable surfaces at less than 3% slopes, primarily on level or uniformly sloping surfaces with deposits of uniform depth. They typically exhibit a sandy clay loam horizon with oxidized colors and clay enrichment over coarse sand (Eckerle and Taddie 1997) and occur on old floodplains, fans, and terraces. The soils are typically sandy and have formed in coarse sandy alluvium (ERO Resources Corporation 1988:49). Plastino (Plastino and Randolph 2000:4) describes the soils as "sandy loam above coarse sand with an increasing gravel content with increasing depth." According to Eckerle and Taddie (1997:8), "The [San Arcacio] soil is formed into a coarse, moderately well-sorted, subangular to subrounded, nonfrosted sand, [the] exact genesis of which is not presently known." They argue that the source material of the sand does not appear to be local. The depth of the sand deposit exceeds 4 meters in at least one location.

Eckerle and Taddie (1997) state that the San Arcacio soils compare well to the Vonalee-Hiland soil/paleosol documented in other parts of the Wyoming Basin on aeolian deposits that have been stable since the middle Holocene, except that they are slightly older. They suggest that occupation occurred on a sheet deposit intermittently active from sometime before 7,000 years B.P. until approximately 3,700 years B.P., after which the surface stabilized, and the San Arcacio soils began to form. The San Arcacio soils remain the currently existing surface.

Buried cultural features have frequently been encountered in San Arcacio soils during construction in the Sand Draw area. Those features typically range in age from approximately 4,000 years B.P. to greater than 7,000 years B.P. The tops of the features typically occur at depths of only 15–20 centimeters below the ground surface, yet the locales frequently lack any surface manifestation or topographic relief to differentiate them from other portions of the surrounding landscape. The features typically include hemispherical basins with and without rock, as well as housepits and other house remains. They are typically encapsulated within the aforementioned sandy clay loam soil horizon and exhibit remarkable preservation.

3.3.6 Discovered Sites

In recent years, prehistoric site discoveries have occurred in a number of management contexts. Those contexts include discoveries at previously recorded archaeological sites at which subsurface components were not expected or detected (sometimes despite extensive, small-scale subsurface testing and/or magnetometer surveys across the entire site), previously unidentified sites with (often very sparse) surface expressions, and previously unidentified sites lacking any surface expression. The latter sites are by far the most prevalent discoveries and the most problematic because no favorable or adequate current methodology exists to identify them in a cost- and time-effective manner prior to such construction that tends to expose them.

Discoveries have occurred in a number of different construction contexts, including well pad stripping and leveling, access road construction, and pipeline trench construction. In portions of the JIDPA (i.e., Stud Horse Butte, Corona, and Cabrito units), nearly one in six projects have yielded discoveries (TRC Mariah 2001c).

The majority of the archaeological site discoveries to date have occurred at a relatively shallow depth (15–30 centimeters) in sheet deposits. The best known of those deposits are the San Arcacio soils of the Sand Draw area. Other sediment types in the JIDPA, away from the Sand Draw terraces, have yielded discoveries in often geomorphologically complex contexts that have also proven difficult to identify by surface analysis and preconstruction testing. These discoveries generally have not been as significant or as time-consuming to mitigate as the Archaic structural remains that are mostly found in the San Arcacio soil contexts along Sand Draw.

Discovered archaeological sites have included locales with housepits or other structural remains and basins with low to moderate densities of artifacts, locales with stained layers and basin features with moderate densities of associated flaked stone artifacts and bone, locales consisting primarily of basin features with few associated artifacts, and locales with a single hearth or cultural stain. Incidentally and paleontologically, fossils tentatively identified as Pleistocene horse bones, a very rare occurrence in Wyoming, have also been discovered during construction activities.

Prehistoric house remains initially identified during well pad or access road construction have been partially or completely excavated at a minimum of seven sites in the JIDPA to date. They include the remains of 17 housepits or surface structures excavated at the McKeva Ryka site (Site 48SU2094), Jonah's House site (Site 48SU2324), and J. David Love site (Site 48SU4479), and Sites 48SU3835, 48SU2317, 48SU3291, and 48SU3519. The houses generally had interior firepits, but few flaked stone artifacts, bone fragments, or other remains were associated with most of the houses.

A human burial dated at 7,290 years B.P. was encountered in a shallow circular pit at the J. David Love site (McKern and Current 2004). Although habitation features were discovered subsurface as a result of construction activities, the actual human remains were found during subsequent archaeological salvage excavations at that discovery site. This burial represents the earliest known human remains from Wyoming and is one of the earliest known burials from the entire Rocky Mountain region. As of August 2004, only this single prehistoric human burial has been encountered within a discovery scenario.

3.3.7 Highly Sensitive Archaeological Locales

This section discusses the most highly sensitive and threatened archaeological locales in the JIDPA. Development and implementation of specific activity plans may be necessary to ensure that these valuable resource areas are adequately protected from impacts directly or indirectly related to JIDPA development.

3.3.7.1 Sand Draw/Bull Draw Divide

The Sand Draw/Bull Draw Divide upland is one of the most sensitive and complex prehistoric archaeological locales currently known for the JIDPA. During 2000–2001, it was the subject of an intensive block inventory for cultural resources, followed by formal recording and evaluation of archaeological sites (Miner 2001). The site complex has been designated the “Site 48SU4000 Archaeological District” and is also known as the “Vlcek Archaeological District.” This is the first Archaeological District established within the PFO.

The District is characterized by sandstone outcrops containing vertical rock faces, overhangs, nooks, and boulders bordering and enclosing sand-filled openings and pockets. A nearly continuous scatter of cultural material is present across that area. Identified archaeological features and remains include numerous rockshelters and alcoves containing cultural deposits, stone circles, buried hearths, areas of culturally stained sediment, numerous projectile points and point fragments, abundant bifaces and other flaked stone tools, ceramics, abundant obsidian artifacts, groundstone, at least one sandstone abrader, abundant burned bone, and mussel shell, among other artifacts. Rock art is conspicuously absent from the cultural remains noted to date, despite the presence of suitable rock faces. Prehistoric human burials or internments also have not been identified to date, although their occurrence somewhere within or around the rock outcrops is quite possible within the District.

Much of the described cultural remains apparently date to the Late Prehistoric period (primarily to the Firehole phase) but all other temporal periods are represented as well. Projectile points and point fragments typically include small side-notched points. Small triangular points and at least one base-notched point have also been recovered. Potsherds were recovered from at least five loci within the locale, some of which apparently closely resemble the ceramics from the Wardell Bison Kill site. Small- and medium-sized corner-notched points and point fragments are also present. A Folsom point was also reportedly collected from one locale within the site complex. Numerous clusters of artifacts were thought to be collectors’ piles and indicators of extensive vandalism. Miner (2001) refutes this, however, making a strong argument that most of the piles are the result of packrat activity.

The Site 48SU4000 Archaeological District is an exceedingly significant complex of cultural properties unique to the region. The area is also considered highly sensitive by Native Americans. The types, density, and diversity of the cultural remains all contrast sharply with the remains typically encountered in the JIDPA and the region. The District contains numerous areas of apparently intact deposits containing dense, well-preserved remains with rich data potential. Moreover, it appears to have significant and perhaps unique potential to provide insight into some of the more distinctive and prominent cultural manifestations known in the region, especially from the Late Prehistoric period, including potentially the poorly understood but distinctive cultural manifestation represented at the nearby Wardell Bison Kill site. There is also a possibility of relict Folsom and other Paleoindian deposits in isolated nooks or pockets.

3.3.7.2 Sand Draw Playa Complex

The Sand Draw playa is situated toward the lower (western) end of Sand Draw approximately 700 feet south of the stream channel. It is encircled by a low rim around its western, southern, and eastern sides but opens north toward Sand Draw. It has been modified by historic ranching activity by way of a ditch into Sand Draw. Surface lands in the playa area are privately owned. Another large enclosed depression is located slightly less than 1 mile to the north, and a smaller enclosed depression is located just over 0.5 mile to the north-northwest, north of Sand Draw.

Both of these depressions are on BLM surface lands. Neither of these depressions are presently mapped as playas, but both may have been playas in the past and they suggest that a complex of playas may have once been present in the area.

The playa complex area may have served as a focus for Paleoindian period occupations. A similar playa complex in the Jonah Gulch site complex (including Sites 48SU389, 48SU907, 48SU908, and 48SU909), located approximately 12 miles to the southeast, contains extensive Paleoindian components. To date, no significant intact Paleoindian components have been identified in the vicinity of the Sand Draw playa complex. However, both a Folsom point and a point tentatively identified as Goshen or Dalton have been recovered as surface finds, suggesting that such components may be present.

The Sand Draw playa complex, due to its capture of more moisture than other JIDPA locations, may preserve archaeologically important paleoclimatic data. Specifically, pollen, which usually is not preserved or recovered from archaeological deposits in other JIDPA locations, may be well preserved in the playa complex. These data are critical for establishing baseline information concerning the paleoenvironmental reconstruction of the JIDPA.

Plastino (1999) noted two soil types within the playa complex area during testing at Site 48SU3090 in a sheltered backslope context with colluvial and aeolian deposits, and in a lower slope/drainage bottom context characterized by slopewash deposits. Testing and monitoring have indicated the presence of intact subsurface deposits of both types, including a basin well out into and under modern playa deposits at a depth of 25 centimeters below the ground surface at Site 48SU3089 at the northern tip of the playa. A stain of possible cultural origin was also noted at a greater depth of 51 centimeters.

Three sites adjacent to the Sand Draw playa were tested as part of an archaeological testing program associated with a non-archaeological geophysical exploration project (Kohler et al. 2003). The sites (Sites 48SU2662, 48SU3087, and 48SU3090) were selected because of their abundant surface artifacts and potential to contain buried Paleoindian cultural remains. These sites had been previously avoided by development projects, and little subsurface testing has been performed as a result. The limited testing program implemented in 2002 (Kohler et al. 2003) revealed few, if any, cultural remains at the three sites, and no intact cultural components were identified. The tested areas generally exhibited colluvial/slopewash deposits and did not contain San Arcacio soils.

Archaeological site discoveries made during testing and monitoring indicate that the Sand Draw playa area is characterized by a large proportion of hearth basin types not commonly represented in other parts of the JIDPA. They include cobble-lined and cobble-filled basins, bell-shaped basins, and U-shaped basins (e.g., at Sites 48SU3049, 48SU3850, and 48SU3089). Point types noted in the area include a McKean complex point, a point described as a “Pelican Lake or Rose Spring” point, and a Rose Spring point. The apparent McKean point is consistent with age estimates obtained from features in the complex, including estimates of 3,580 and 3,900 years B.P. from a cobble-lined basin and a bell-shaped basin, respectively, which suggest the presence of intact McKean complex components in the area.

These patterns suggest that the playa complex may have been a locus of different procurement/processing activities and/or of more concentrated occupation by different groups and/or at different times than other portions of the JIDPA. Therefore, sites in the area have the potential to provide distinct and important information concerning prehistoric land use patterns in the JIDPA and the region.

3.3.7.3 Central Sand Draw

Terraces along the central part of Sand Draw contain a concentrated locus of early to mid-Holocene housepits and other structural remains and contemporaneous basin features, as was discussed above with regard to the Sand Draw/Bull Draw Divide. This segment of Sand Draw lies below and to the west of Stud Horse Butte at its upper end and above the Sand Draw playa at its lower end. The housepit occupations may have been intentionally positioned in proximity to the playa complex.

Plastino (1999) describes a series of at least three terraces above Sand Draw. He estimates the three terraces occur at 2 meters, 4 meters, and >4 meters above the modern Sand Draw channel. He describes two of the terraces as strath terraces with nearly level treads. Sediments across the lower terraces are classified as San Arcacio soils.

As part of the geophysical exploration project mentioned above, four sites were selected for archaeological testing along Sand Draw to investigate areas of interest that are usually avoided during development projects (Kohler et al. 2003). Sites in the testing program along Sand Draw included Sites 48SU1779, 48SU2246, 48SU3088, and 48SU4011. Most of the site testing was conducted in San Arcacio sediments, and the majority of cultural material was recovered from San Arcacio strata. Two San Arcacio strata were identified: San Arcacio "A" stratum was interpreted as post-dating 3,000 years B.P., and San Arcacio "B" stratum was the lower, older layer dating between 3,000 and 7,000 years B.P. Site 48SU2246 was the only site tested that did not contain San Arcacio soils. Ceramic and obsidian artifacts were found on the surface of this site, and additional pieces of pottery were recovered from the test unit. Site 48SU2246 appears to date to the Late Prehistoric period based on the ceramic assemblage, while the remaining sites appear to date to the Archaic period based on their presence in San Arcacio soils. Only a few cultural features were identified in the 67 square meters of excavation, none were structural, and none were radiocarbon dated. Few of the test units yielded more than a small number of artifacts or other types of cultural remains. Recent notable housepit/structure data recovery excavations along Sand Draw have occurred at the McKeva Ryka site (Site 48SU2094), Jonah's House site (Site 48SU2324), the J. David Love site (Site 48SU4479), Site 48SU3835, and Site 48SU3519. These sites are all located on the Sand Draw terraces in San Arcacio sediments, and all were excavated to mitigate impacts to features encountered during well pad or access road construction.

The McKeva Ryka site contained two housepits with postholes and interior and exterior features (McKern and Current 2002). Artifacts included a light scatter of flaked stone and bone. The housepits were radiocarbon dated to between 5,990 and 6,880 years B.P. The housepits appear to represent short-term habitations that were revisited seasonally over hundreds of years.

The Jonah's House site is similar to the McKeva Ryka site in setting, cultural remains, and apparent function. It contained two housepits with postholes and a sparse scatter of artifacts and bone (McKern and Current 2003). It was radiocarbon dated to between 6,590 and 7,070 years B.P. and also is interpreted as representing short-term, repeated habitations.

The J. David Love site is rich in structural remains, containing six housepits and three surface structures dating between 4,590 and 8,210 years B.P. (McKern and Current 2004). A pit feature in one of the housepits contained human burial remains dating to 7,290 years B.P. The burial represents the remains of an elderly woman, and it is suggested that the structure was constructed specifically for the burial. Artifacts at this site were sparse but did include fragments of red ochre.

Site 48SU3835 included a single, flat-floored surface structure with 26 postholes, six internal features, and an intact roof layer (Nelson and Richard 2004). A sparse scatter of lithic artifacts was present on the site surface, but a magnetometer survey of the area conducted prior to well pad blading did not yield evidence of buried cultural remains. Radiocarbon dates from the discovery ranged from 5,600 to 8,240 years B.P. Of particular interest was the presence of about 300 pieces of microdebitage (small discarded materials such as flakes) and about 1,000 small bone fragments recovered from feature fill. The recovery of this quantity of artifacts from a single structure is uncommon.

Site 48SU3519 was not identified during the Class III inventory that included magnetometer survey, but well pad construction revealed a cluster of 10 basin features and 11 scattered basin features (Sines and Roufs 2001). Twenty-five flakes and approximately 800 small pieces of bone were recovered from the heavy fraction of flotation fill samples. A series of possible post molds associated with the feature cluster suggests that this site also contained a shelter. Six age estimates ranging from 4,050 to 7,110 years B.P. were obtained from the features.

The housepits and other features in the central Sand Draw area provide excellent potential to contain cultural material from a time period that is crucial for understanding North American prehistory, particularly the Paleoindian-Archaic lifeway transition and hunter-gatherer adaptation to the severe climatic conditions of the Altithermal climatic episode. Intact buried components dating to that time period are uncommon, as are concentrations of housepit loci. The combination of the two in central Sand Draw would be unparalleled anywhere in the western United States.

3.4 SOCIOECONOMICS

Unless otherwise cited, the socioeconomic information that follows has been summarized from the Socioeconomic Analysis Technical Support Document for the Jonah Infill Drilling Project Environmental Impact Statement (BLM 2005). This document is available from the BLM PFO. Please refer to that document for more detailed socioeconomic information and analysis. Additional information has been taken from the socioeconomic profile (BLM 2003d) prepared for inclusion in the new Pinedale RMP (now in preparation). Unless otherwise stated, all dollar amounts are presented in year 2000 dollars, adjusted for inflation. Formulas used to make the calculations presented herein (e.g., change, average annual change) are illustrated and explained in detail in BLM's socioeconomic technical support document (2005).

3.4.1 Study Area

The economic study area (i.e., the CIAA) includes the counties and communities most likely to be impacted by the proposed project, including LaBarge in Lincoln County; Pinedale, Big Piney, Marbleton, and Boulder in Sublette County; and Eden, Farson, and Rock Springs in Sweetwater County. Rock Springs is a hub of natural gas development activity and likely will be home to some of the workers. Wyoming and the United States are also included in the profile and impact analyses (see Section 4.4) where information is available and pertinent. The three-county area and the listed communities also comprise the CIAA.

3.4.2 Demography

3.4.2.1 Population Dynamics and Census Data

Population data were obtained from the U.S. Census Bureau (2000a, 2000b, 2000c, 2000d, 2005a, 2005b, 2005c), Taylor and Lieske (2002a), and the Wyoming Department of Administration and Information (WDAI) (2001a, 2001b, 2002a, 2002b, 2003a, 2004, 2005a). EPS uses BEA population data, which differ from census totals; however, percentages tend to approximate calculations based on census data.

Lincoln County

As shown in Table 3.23, Lincoln County population increased by 19.7% between 1980 and 2000 (EPS, using BEA population estimates, indicated an 18% increase in population). Wyoming census population estimates for 2004 show that the county continues to grow, experiencing an approximate 7.0% growth increase between 2000 and 2004 (see Table 3.23) (WDAI 2004). Census data for urban and rural populations for Lincoln County are provided in Table 3.24. Unlike the State of Wyoming, the majority of Lincoln County residents in 2000 lived in rural areas.

LaBarge is the community in Lincoln County that is most likely to be affected by the proposed project. As summarized in Table 3.23, LaBarge's growth has fluctuated since 1980. Between 1980 and 2000, LaBarge had a 42.7% increase in population. However, Census 2004 population estimates reflect a 2.8% decline in population since 2000 (U.S. Census Bureau 2005a).

Sublette County

The Sublette County population in 2000 was 5,920, up from 4,843 (22.2%) in 1990 and up from 4,548 (30.2% overall) in 1980 (U.S. Census Bureau 2000a, 2000b) (see Table 3.23). U.S. Census estimates indicate the county's population continues to increase, growing approximately12.4% between 2000 and 2004 (U.S. Census Bureau 2005a). Sublette County had no urban clusters or urban areas as defined by the U.S. Census Bureau. Thus, the entire population was considered rural; 8% of the county's population resided on farms, while 92% were considered non-farm residents (U.S. Census Bureau 2000d) (see Table 3.24).

Pinedale, Big Piney, Marbleton, and Boulder in Sublette County are the communities most likely to be affected by the proposed project. Bondurant, Cora, and Daniel may also be affected. Census data for Bondurant, Boulder, Cora, and Daniel were not collected until the 2000 census. In 2000, Pinedale had the largest population in Sublette County (1,412), while Boulder had the smallest population in the entire study area (30) (see Table 3.23). According to U.S. Census Bureau estimates, the communities of Pinedale, Marbleton, and Big Piney in Sublette County all experienced growth between 2000 and 2004 (U.S. Census Bureau 2005b). Population increases for each community are provided in Table 3.23.

Sweetwater County

The Sweetwater County population in 2000 was 37,613, down from 38,823 (-3.1%) in 1990 and from 41,723 in 1980, thus the decrease over the 20-year study period was 9.9% (-4,110) (U.S. Census Bureau 2000a, 2000b) (see Table 3.23). According to U.S. Census Bureau estimates, population in the county increased slightly between 2000 and 2004 (.04%) (U.S. Census Bureau 2005a).

Table 3.23. Historic and Projected Population

Location	Population[1]				Total Change in Population (%)[1]				Projected Population[1]				
	1980[2]	1990[2]	2000[2]	2004[1,3,4]	1980–1990	1990–2000	1980–2000	2000–2004	2005[5,6]	2010[5,6]	2015[5,6]	2020[5,6]	2025[5,6]
U.S. (thousands)	226,542	248,709	281,421	293,655	9.8	13.2	24.2	4.3	295,507	308,935	322,365	335,804	349,439
State of Wyoming	469,557	453,588	493,782	506,529	-3.4	8.9	5.2	2.6	506,184	519,595	529,352	533,534	529,031
Lincoln County	12,177	12,625	14,573	15,626	3.7	15.4	19.7	7.2	15,551	16,466	17,275	17,868	NR
LaBarge	302	493	431	419	63.2	-12.6	42.7	-2.8	442	468	490	507	NR
Sublette County	4,548	4,843	5,920	6,654	6.4	22.2	30.2	12.4	6586	7161	7697	8135	NR
Big Piney	530	454	408	444	-10.1	-1.3	-23.0	8.8	452	491	528	558	NR
Bondurant	NR	NR	155	NR	--	--	--	--	NR	NR	NR	NR	NR
Boulder	NR	NR	30	NR	--	--	--	--	NR	NR	NR	NR	NR
Cora	NR	NR	76	NR	--	--	--	--	NR	NR	NR	NR	NR
Daniel	NR	NR	89	NR	--	--	--	--	NR	NR	NR	NR	NR
Marbleton	537	634	720	789	18.0	16.9	34.1	9.6	804	874	940	993	NR
Pinedale	1,066	1,181	1,412	1,575	10.7	20.3	32.5	11.5	1,552	1,688	1,814	1,918	NR
Sweetwater County	41,723	38,823	37,613	37,758	-6.9	-3.1	-9.9	0.4	36,645	35,567	34,293	32,759	NR
Eden	NR	NR	388	NR	--	--	--	--	NR	NR	NR	NR	NR
Farson	NR	NR	242	NR	--	--	--	--	NR	NR	NR NP	NR	NR
Rock Springs	19,458	19,050	18,708	18,746	-2.1	-1.7	-3.9	0.2	18,211	17,670	17,038	16,275	NR

1 NR = not reported; -- = not calculated due to lack of information; NP = no projection available at this geographic level.
2 Wyoming Department of Administration and Information. 2000. 1990 Census of Population and Housing: Profiles for State, Counties, and Major Cities and Towns. <http://eadiv.state.wy.us/pop90/pop90.htm>. Data accessed June 17, 2000 WDAI (2001a). Information for Bondurant, Boulder, Cora, Daniel, Eden, and Farson was not collected until the 2000 census. U.S. Census Bureau information was not collected for LaBarge until the 1990 census; however, WDAI reported 1980 estimates (WDAI 2001a).
3 Source: U.S. Census Bureau (2005a).
4 Source: U.S. Census Bureau (2005b).
5 Source: U.S. Census Bureau (2005c).
6 Source: WDAI (2004).

Table 3.24. Urban and Rural Population and Density, 2000

Location	Population[1]				Density per Square Mile
	Urban	Rural			
		Total	Farm[2]	Non-Farm[2]	
United States					
No. of People	222,358,309	59,063,597	2,987,531	56,076,066	79.6
Percent	79%	21%	5%	95%	NA
State of Wyoming					
No. of People	322,073	171,709	15,150	156,559	5.1
Percent	65%	35%	9%	91%	NA
Lincoln County					
No. of People	2,958	11,653	718	10,897	3.6
Percent	20%	80%	6%	94%	NA
Sublette County					
No. of People	–[3]	5,920	477	5,443	1.2
Percent	–	100%	8%	92%	NA
Sweetwater County					
No. of People	33,512	4,101	416	3,685	3.6
Percent	89%	3%	10%	90%	NA

1 U.S. Census Bureau (2000a).
2 Total rural residents living on farms and not living on farms.
3 Sublette County has no urban population as defined by the U.S. Census Bureau.

Sweetwater County had a population density of 3.6 people/square mile; however, unlike Sublette County, 89.1% (33,512) of the Sweetwater County population lived in urban clusters (U.S. Census Bureau 2000d) (see Table 3.24). Of the 4,101 rural residents, only 416 (10.1% of rural residents; 1.1% of county residents) resided on farms. Rock Springs is the community most likely to be affected in Sweetwater County. Eden and Farson may also be affected, though minimally. No census data were collected for Eden and Farson until 2000. Rock Springs reflected Sweetwater County's trend, declining 2.1% between 1980 and 1990 and 1.7% between 1990 and 2000. Overall, Rock Springs experienced a 3.9% decrease in growth from 1980 to 2000 (see Table 3.23). Conversely, similar to Sweetwater County, U.S. Census Bureau population estimates reflect a slight increase in growth (0.2%) between 2000 and 2004 (U.S. Census Bureau 2005a, 2005b). In 2004, Rock Springs had the largest estimated population in the entire study area (18,746) (see Table 3.23).

3.4.2.2 Income, Poverty, and Unemployment

Income, poverty, and unemployment data are presented in Table 3.25. Households throughout the United States experienced increased income over the 20-year study period, although poverty levels remained relatively static and unemployment decreased. The median household income throughout the U.S. increased by approximately 13% between 1980 and 1990 and by 6% between 1990 and 2000, with a total increase of 19% (<1% average annual increase) over the course of the 20-year study period. U.S. Census Bureau estimates indicate that the median household income for the U.S. grew 3.2% between 2000 and 2002 (U.S. Census Bureau 2004) (see Table 3.25).

Table 3.25. Income, Poverty, and Unemployment

Location	Median Household Income[1,2] ($)				Personal Per Capita Income[1,2] ($)				Poverty Rate[1,2] (%)				Unemployment Rate[1,2] (%)			
	1980[3]	1990[4]	2000[5]	2002[6] Estimate	1980[3]	1990[4]	2000[5]	2003[12]	1979[3]	1989[7]	1999[5]	2002[6] Estimate	1980[8,9]	1990[9,10]	2000[10,11]	2003[12]
U.S.	35,194	39,599	41,994	43,318	21,280	25,787	29,469	31,472	12.4	11.8	12.4	12.1	7.1	5.6	4.0	6.0
Wyoming	41,784	35,700	37,892	39,772	24,561	23,696	27,372	32,433	7.9	11.2	11.4	10.6	4.0	5.5	3.9	4.4
Lincoln County	37,627	37,534	40,794	44,567	19,602	19,071	20,980	27,156	11.5	11.1	9.0	9.1	6.0	6.6	5.2	5.8
LaBarge	NR	12,142	18,837	NR	NR	6,995	18,837	NR	NR	24.5	12.3	NR	NR	NR	NR	NR
Sublette County	36,425	35,343	39,044	45,765	25,201	24,746	26,927	33,936	9.7	8.8	9.7	7.3	2.7	2.9	3.8	2.8
Big Piney	NR	15,418	17,647	NR	NR	8,882	17,647	NR	NR	6.2	11.5	NR	NR	NR	NR	NR
Bondurant	NR	NR	19,432	NR	NR	NR	19,432	NR	NR	NR	19.2	NR	NR	NR	NR	NR
Boulder	NR	NR	12,500	NR	NR	NR	NR	NR	NR	NR	33.3	NR	NR	NR	NR	NR
Cora	NR	NR	20,831	NR	NR	NR	20,831	NR	NR	NR	7.9	NR	NR	NR	NR	NR
Daniel	NR	NR	21,213	NR	NR	NR	21,213	NR	NR	NR	24.4	NR	NR	NR	NR	NR
Marbleton	NR	15,125	18,446	NR	NR	8,713	18,446	NR	NR	10.1	4.2	NR	NR	NR	NR	NR
Pinedale	NR	17,030	20,441	NR	NR	9,811	20,441	NR	NR	12.9	8.9	NR	NR	NR	NR	NR
Sweetwater County	50,394	47,707	46,357	50,801	10,955	16,810	28,037	32,941	5.2	7.4	7.8	7.9	3.7	5.5	4.8	4.3
Eden	NR	NR	52,625	NR	NR	NR	18,392	NR	NR	NR	17.6	NR	NR	NR	NR	NR
Farson	NR	NR	44,545	NR	NR	NR	16,140	NR	NR	NR	0.0	NR	NR	NR	NR	NR
Rock Springs	19,525	19,456	51,539	NR	4,471	11,208	19,396	NR	5.8	8.5	9.4	NR	NR	NR	NR	NR

1 NR = not reported.
2 All national, state, and local area dollar estimates are in Year 2000 dollars adjusted for inflation based on U.S. average consumer price index (for urban consumers). EPS uses the urban consumer base; therefore, it was also applied to inflation adjustments for this technical report to maintain consistency. Median household income is for all geographic units; personal per capita is for towns and cities. Poverty rate is the percent of people in poverty. Unemployment rate is the percentage of people actively seeking work but unemployed.
3 Source: U.S. Census Bureau (1981) (based on 1979 income).
4 Source: U.S. Census Bureau (1990) (based on 1989 income).
5 Source: U.S. Census Bureau (2000c) (based on 1999 income).
6 Source: U.S. Census Bureau (2004) (based on 2003 income
7 Source: WDAI (2001b). Poverty rate is the percent of people in poverty.
8 Source: WDERP (2002a).
9 Source: BLS (2003).
10 Source: WDERP (2002b).
11 Source: WDERP (2002c).
12 Source: WDAI (2005b) .

Personal per capita income increased 21% from 1980 to 1990 and again increased (14%) from 1990 to 2000, for a total increase of 38% (slightly less than 2% average annual increase) over the 20-year study period. Wyoming estimates imply a similar trend for the state as a whole, with a 7% increase in personal per capita income between 2000 and 2003 (WDAI 2005b). Overall, for the 20-year study period, poverty levels did not change in the U.S., although they dropped slightly from 1979 to 1989 then increased again by 1999 (U.S. Census Bureau 1981, 1990, 2000a) (see Table 3.25). The unemployment rate in the U.S. dropped throughout the 20-year study period, from 7.1% (1980) to 4.0% (2000). The unemployment rate rose to 6.0% in 2003 (BLS 2003,WDAI 2005b).

The median household income throughout Wyoming fell by nearly 15% between 1980 and 1990 and grew 6% between 1990 and 2000, for a total decline of 9% over the course of the 20-year study period (-0.5% average annual decline]) (see Table 3.25). The state's median household income grew 5% between 2000 and 2002 (U.S. Census Bureau 2004).

The median household income in Lincoln County fell by 0.2% between 1980 and 1990, then grew by nearly 9% between 1990 and 2000, for an overall increase of 8% for the 20-year study period (0.4% average annual increase). Between 2000 and 2002, median household income increased by 9.2% (see Table 3.25) (U.S. Census Bureau 2004). The median household income in Sublette County fell by nearly 3% between 1980 and 1990, then increased by 10% between 1990 and 2000, for an overall increase of 7% (0.4% average annual growth) over the 20-year study period. Household income increased 17.2% from 2000 to 2002 (U.S. Census Bureau 2004). The median household income in Sweetwater County fell by 5% between 1980 and 1990 and fell again by 3% between 1990 and 2000, for an overall decrease of 8% (-0.4% average annual change) over the course of the 20-year study period (see Table 3.25). Median household income increased 9.6% from 2000 to 2002 (U.S. Census Bureau, 2004).

Personal per capita income in 2000 in Wyoming was $27,372, whereas personal per capita income in the study area ranged from $28,037 in Sweetwater County to $20,980 in Lincoln County (see Table 3.25). The poverty rate in Wyoming was 11.4% in 1999, while poverty rates in the study area ranged from 33.3% in Boulder (Sublette County) to 0.0% in Farson (Sweetwater County) (U.S. Census Bureau 2000a).

In distinct contrast to national increases, Wyoming's personal per capita income fell by 3.5% from 1980 to 1990 but experienced a recovery of 15.5% from 1990 to 2000, for an overall increase of 11.4% (only 0.5% average annual growth) over the 20-year study period (see Table 3.25). This trend continues with an 18% increase in personal per capita income from 2000 to 2003 (WDAI 2005b) From 1980 to 2000, personal per capita income in Lincoln County increased 7.0% but only slightly exceeded the poverty level ($18,244), Sublette County increased by 6.8%, and Sweetwater County increased 155.9%.

In Wyoming, the poverty rate increased over the 20-year study period, from 7.9% in 1979 to 11.4% in 1999 (U.S. Census Bureau 1981, 1990, 2000a). During the two-year span between 2000 and 2002, the poverty rate decreased to 10.6 (U.S. Census Bureau 2004).

The unemployment rate for Wyoming rose from 1980 (4.0%) to 1990 (5.5%), then decreased to 3.9% by 2000 Wyoming Department of Employment, Research, and Planning (WDERP) 2002a, 2002b, 2002c). In 2003, the unemployment rate for Wyoming rose slightly to 4.4% (WDAI 2005b). In Lincoln County, the poverty rate decreased slightly from 1979 (11.5%) to 1989 (11.1%) and decreased again to 9.0% by 1999. The poverty rate rose slightly to 9.1% in

2002 (U.S. Census Bureau 2004). In Sublette County, it decreased from 9.7% in 1979 to 8.8% in 1989 but, despite the gains in personal income, increased back to 9.7% by 1999. The poverty rate decrease to 7.3 in 2003 (U.S. Census Bureau 2004). In Sweetwater County, the poverty rate increased 42% 1979–1989 but only increased 5% 1989–1999 and remained constant 2002–2004 (U.S. Census Bureau 1981, 1990, 2000c, 2004; WDAI 2001b).

Similar to that experienced by the state, unemployment followed a rise-and-fall pattern in the study area. In Lincoln County the unemployment rate increased from 6.0% in 1980 to 6.6% in 1990, then falling to 5.2% in 2000 and increased again to 5.8 in 2003 (WDERP 2002a, 2002b, 2002c, WDAI 2005b). The 2000 unemployment rate in Sublette County (3.8%) was lower than the state overall and was the lowest unemployment rate in the study area. The unemployment rate increased from 2.7% in 1980 to 3.8% in 2000 and then decreased to 2.8 in 2003 (WDERP 2002a, 2002b, 2002c, WDAI 2005b). In Sweetwater County, the unemployment rate increased from 3.7% in 1980 to 5.5% in 1990, then decreased to 4.8% by 2000 and to 4.3% in 2003 (WDERP 2002a, 2002b, 2002c; WDAI 2005b).

Data were not collected for LaBarge until the 1990 census. LaBarge has experienced trends similar to the state, with median household income increasing by approximately 55.1% (4% average annual growth [see BLM 2005 for formula used to calculate average annual growth]) from 1990 to 2000 (see Table 3.25). Personal per capita income increased more than 169.3% (10% average annual growth) between 1990 and 2000. Despite the dramatic increase, the per capita income of LaBarge barely exceeds the poverty level (set at $18,244). The poverty rate has significantly decreased—from 24.5% in 1989 to 12.3% in 1999—however, it still exceeds the poverty rate in both the state and county, as well as the other counties in the study area.

Complete information for the potentially affected communities in Sublette County is not available for all study years. Big Piney, Marbleton, and Pinedale have experienced increases in both median household income and personal per capita income since 1980 (see Table 3.25). Marbleton had the highest increase in median household income (22.0%; 2.2% average annual growth) and personal per capita income (111.7%; 8% average annual growth). Despite the increase, the per capita income of Marbleton barely exceeds the poverty level. No personal per capita income is reported for Boulder. The median household income in Boulder in 2000 was only $12,500—68.5% of the poverty level (set at $18,244). The highest reported poverty rates in the three-county study area in 2000 were in Sublette County: Boulder (33.3%), Daniel (24.4%), and Bondurant (19.2%). Although poverty in Sublette County has remained relatively stable, the poverty rates in Marbleton and Pinedale have decreased since 1989.

Rock Springs experienced a decline in median household income (-0.4%) from 1980 to 1990 but experienced an increase (164.9%) from 1990 to 2000, for an overall increase of 164.9% (5.0% average annual growth) over the 20-year study period (see Table 3.25). Personal per capita income increased (150.7%) from 1980 to 1990 and again from 1990 to 2000 (73.1%), for an overall increase of 333.8% (8% average annual growth) over the course of the 20-year study period. Despite the increase in personal income, the poverty level increased from 5.8% in 1979 to 8.5% in 1989 and continued to rise to 9.4% by 1999 in Rock Springs.

Information for Eden and Farson in Sweetwater County was not collected until the 2000 census. However, the median household income in Eden was the highest in the three-county study area ($52,625), and Farson had the lowest poverty level in the three-county study area in 1999 (0.0%) (see Table 3.25).

3.4.2.3 Workforce Age, Gender, and Disabilities

Workforce information was obtained from the U.S. Census Bureau (2000e, 2000f). For the purposes of this report, the civilian labor force is defined as all persons between 16 and 66 years of age (retirement age is 67) in the civilian non-institutional population who either had a job or were looking for a job in the last 12 months and who did not have an employment disability. For the purposes of the last census, employment disability was defined as a condition lasting for 6 months or more:

- that limited the kind or amount of work that he or she could do at a job,
- that prevented him or her from working at a job,
- that made it difficult to go outside the home alone (for example, to shop or visit a doctor's office), and
- that made it difficult to take care of his or her own personal needs such as bathing, dressing, or getting around inside the home.

Based on the age of residents, employment disability information, and unemployment rates in each county, there is a civilian labor force of approximately 1,719 unemployed working-age residents available for employment in the study area (Table 3.26). However, there may be some disconnect between published data and actual available labor. A labor shortage has been reported in all sectors in Sweetwater County, with as many as 600 job vacancies existing in November 2004 (Mast 2004). Additionally, Halliburton has reported having difficulty filling the 100 new jobs created by its new facility in Rock Springs (Mast 2004).

3.4.3 Housing

Historical information on housing in Lincoln, Sublette, and Sweetwater Counties was obtained from the WDAI (2002a), and information on projected housing availability was obtained from the Wyoming Business Council (2002); these data are presented in Table 3.27. Numbers of authorized building permits for 1980–2004 were obtained from the Wyoming Housing Database Partnership (WHDP) (2005) and are listed in Table 3.28. Rental rates and costs in the three counties as compared to those for the state as a whole were obtained from WDAI (2003b, 2005c) (Table 3.29), and information on second homes housing units in the study area was obtained from Taylor and Lieske (2002b) (Table 3.30). Housing data reported in Tables 3.27–3.30 provide an overall view by state and affected county and are not intended to reflect conditions within particular communities (e.g., Pinedale) that have already been impacted by other projects (e.g., Pinedale Anticline Project) in the area. For example, information and data on housing in Sublette County provided by the Pinedale Anticline Working Group (PAWG) SocioEconomic Task Group Monitoring Plan (2005) are more specific to local conditions than the data generated from WHDP and are used to supplement the data from both state and census sources.

Table 3.26. Population and Workforce, 2000[1]

Sex and Age	United States	Wyoming	County		
			Lincoln	Sublette	Sweetwater
Male					
0-15 years	32,919,334	57,604	1,985	680	4,727
16-66 years	92,539,411	168,540	4,627	2,080	13,168
67 years and over	12,594,818	22,109	763	281	1,072
Total males	138,053,563	248,253	7,375	3,041	18,967
Female					
0-15 years	31,353,445	54,266	1,901	663	4,515
16-66 years	93,508,194	162,400	4,455	1,926	12,533
67 years and over	18,506,704	28,863	842	290	1,598
Total females	143,368,343	245,529	7,198	2,879	18,646
Total all ages	281,421,906	493,782	14,573	5,920	37,613
Total working age	186,047,605	330,940	9,082	4,006	25,701
Persons with disabilities[2]	57,890,659	30,952	633	325	1,942
Total potential workforce	128,156,046	299,988	8,449	3,681	23,759
Unemployment rate	4.0%	3.9%	5.2%	3.8%	4.8%
Number of Persons Available for Employment	5,126,241	11,699	439	139	1,140

[1] U.S. Census Bureau (2000e).
[2] U.S. Census Bureau (2000f).

According to the WHPD (2003), there were 4,579 vacant units available for housing in the study area in 2003, with the vacancy rate ranging from 12.8% in Sweetwater County to 31.8% in Sublette County. Average contract rent for a home in the second quarter 2005 ranged from $407 in Lincoln-Kemmerer to $882 in Sublette County (WDAI 2005c). Median monthly mortgage payments were lowest in Sublette County ($847/month) and highest in Sweetwater County ($953/month), although the median house value was lowest in Lincoln County ($95,300) and highest in Sublette County ($112,000) (WHDP 2003).

Some vacant units can be attributable to second home growth in the state, particularly in Sublette County. Between 1990 and 2000 second homes accounted for almost 3,000 new housing units in Wyoming (Table 3.30). This growth represents over 14% of the total increase in housing units for the decade (Taylor and Lieske 2002b). The Census Bureau defines "second home" as housing units that do not serve as the primary residence for their inhabitants. Usually this type of housing is used seasonally for recreation or other purposes (Taylor and Lieske 2002b).

3.4.3.1 Lincoln County

In 2002, Lincoln County had the fewest renter-occupied units (15%, 1,024 units) in the study area. A total of 1,349 units (19.7%) in Lincoln County were vacant in that year. The relatively high percentage of such units may be attributable to the growing number of second homes in the county (912 in 2000, a 46.9% increase over 1990). The greatest number of residential building permits (204) in the study area was issued in Lincoln County (WHDP 2005) (see Table 3.28).

Table 3.27. Historic and Projected Housing Availability

Housing Item	Wyoming						Lincoln					
	Historic				Projected		Historic				Projected	
	1980	1990	2000	2002	2007	2012	1980	1990	2000	2002	2007	2012
Type of Housing[1,2]												
Vacant	22,593	34,572	30,246	38,804	38,706	39,582	812	1,272	1,565	1,349	1,389	1,430
Owner-occupied	114,653	114,544	135,514	139,391	149,399	159,413	3,035	3,310	4,280	4,461	4,869	5,282
Renter-occupied	50,971	54,295	58,094	58,736	60,422	62,098	824	826	986	1,024	1,072	1,116
Total housing units	188,217	203,411	223,854	236,931	248,527	261,093	4,671	5,408	6,831	6,834	7,330	7,828
Percent of Housing[1]												
Vacant	12.0	17.0	13.5	16.4	15.6	15.2	17.4	23.5	22.9	19.7	18.9	18.3
Owner-occupied	60.9	56.3	60.5	58.8	60.1	61.1	65.0	61.2	62.7	65.3	66.4	67.5
Renter-occupied	27.1	26.7	26.0	24.8	24.3	23.8	17.6	15.3	14.4	15.0	14.6	14.3

Housing Item	Sublette						Sweetwater					
	Historic				Projected		Historic				Projected	
	1980	1990	2000	2002	2007	2012	1980	1990	2000	2002	2007	2012
Type of Housing[1,2]												
Vacant	802	1,077	1,181	1,155	1,177	1,201	1,064	1,828	1,816	2,075	2,063	2,107
Owner-occupied	1,121	1,281	1,737	1,820	2,055	2,289	9,470	9,552	10,586	10,722	10,960	11,154
Renter-occupied	470	553	634	652	692	733	4,582	4,065	3,519	3,420	3,168	2,926
Total housing units	2,393	2,911	3,552	3,627	3,924	4,223	15,116	15,445	15,921	16,217	16,191	16,187
Percent of Housing[1]												
Vacant	33.5	37.0	33.2	31.8	30.0	28.4	7.0	11.8	11.4	12.8	12.7	13.0
Owner-occupied	46.8	44.0	48.9	50.2	52.4	54.2	62.6	61.8	66.5	66.1	67.7	68.9
Renter-occupied	19.6	19.0	17.9	18.0	17.6	17.4	30.3	26.3	22.1	21.1	19.6	18.1

[1] Historical data from WDAI (2002a); projected data from Wyoming Business Council (2002d). Reported average availability may not accurately reflect actual availability within particular communities (e.g., Pinedale) that have already been impacted by other projects (e.g., Pinedale Anticline Project) in the area.

[2] Total residential units (i.e., single family units, duplex units, tri- and four-plex units, and multi-family units) (WHDP 2003).

Table 3.28. Authorized Building Permits, 1980–2004[1]

Year	Lincoln County	Sublette County	Sweetwater County
1980	30	82	801
1981	59	104	516
1982	72	101	325
1983	41	100	213
1984	46	72	139
1985	54	67	93
1986	11	68	85
1987	9	34	72
1988	5	21	30
1989	2	19	34
1990	3	37	56
1991	9	59	80
1992	112	50	102
1993	132	53	99
1994	170	74	123
1995	175	94	90
1996	146	69	90
1997	86	46	75
1998	103	68	73
1999	143	75	51
2000	145	54	41
2001	218	76	38
2002	204	88	48
2003	180	95	63
2004	212	93	216

[1] Source: WHPD 2005.

LaBarge is the community in Lincoln County most likely to be affected by the proposed project. According to the Lincoln County Planning Department, the housing market in LaBarge has recently turned a corner and is stabilizing after experiencing a decrease in housing prices for the last several years. Housing in LaBarge is considered available but limited (Woodward 2005).

3.4.3.2 Sublette County

According to the 2000 Census, Sublette County had the highest percent of second home units in Wyoming; a total of 26.2% of all housing units in the county were second homes at that time. In 2002, Sublette County also had the highest officially reported vacancy rate in the study area (31.8%, 1,155 vacant units), and the lowest number of owner-occupied units (50.2%) (see Table 3.27). Between 1990 and 2000 the number of second homes in the county grew by 24.5%, which contributes significantly to the county's very high reported vacancy rate (see Table 3.30). According to the County Assessor's Office, there is a shortage of available housing in Sublette

County (Saxton 2005). Housing shortages in the northern portions of the county are such that the demand for housing has increased the cost of current homes on the market.

Between 1998-2004, the cost for an average single-family home in Sublette County increased by 65% (PAWG). Over the same time frame the statewide increase for an average single-family home was 35%. (PAWG). Due to the housing shortage in the County, waiting lists exist for rental properties. A semi-annual rental vacancy survey conducted by WDAI in Sublette County reported one vacant single-family house and a waiting list of 86 existed in spring 2004 (PAWG).

As a result of the lack of housing and rental market in the County, the PAWG 2005 socioeconomic report and monitoring plan states:

> *Businesses are having to supply employees with housing. Specific examples of this are: White Pine Ski Area converting a building into apartments for employees. Sinclair Gas Station…building an addition for employee housing. Sublette County School District Number One buying housing for teachers and also creating plans for a planned unit development west of Town for teacher housing. Numerous instance of people converting garages into apartments and renting them out. Camping trailers parked on town streets with people staying in them* (PAWG 2005:21).

Between 2000 and 2004, the number of new building permits issued annually in the county increased by 72% (see Table 3.28) (WHDP 2005a). According to PAWG (2005), the housing shortage in Sublette County varies with the most notable shortages occurring in the Town of Pinedale and the surrounding areas. As such, these areas are also experiencing the greatest increase in new housing growth within the County. Within the town limits of Big Piney, a new subdivision is currently being developed, and Pinedale has several new rural subdivisions under construction. A total of 130 residential lots were permitted within a mile of the town of Pinedale in 2004 and 40 residential lots associated with new subdivisions within the town of Pinedale were platted (PAWG 2005). The study states that:

> *Overall, the most significant increases in building are in single-family housing, multi-family housing, motel/hotel units, and the large amount of land being developed around the Town of Pinedale. The percentage increases are extreme. The "fringe area" land development is particularly alarming due to water quality issues arising from a large increase in septic systems* (PAWG 2005:24).

3.4.3.3 Sweetwater County

In 2002, Sweetwater County had the highest number of owner-occupied units (10,722, 66.1%), the highest number of renter-occupied units (3,420, 21.1%), and the lowest vacancy rate (2,075 units, 12.8%) (see Table 3.27). In 2000, the county had 243 second homes, a total of 1.5% of all housing units. Compared to Lincoln and Sublette Counties, Sweetwater County had the greatest increase in second home development between 1990 and 2000, an increase of 77.4% (see Table 3.30). Sweetwater County also had the greatest increase in new building permits issued in the study area. Between 2000 and 2004, the number of new building permits issued in the county increased over 400% (see Table 3.28) (WHDP 2005).

Table 3.29. Average Rental Rates, 2001–2005[1,2,3]

Location	Apartment[4]				House[5]				Mobile Home[6]				Mobile Home Lot[7]			
	Fourth Quarter[1] 2001 ($)	Second Quarter 2002 ($)	Second Quarter 2005[3] ($)	2001–2005 % Change	Fourth Quarter[1] 2001 ($)	Second Quarter 2002 ($)	Second Quarter 2005[6] ($)	2001–2005 % Change	Fourth Quarter[1] 2001 ($)	Second Quarter 2002 ($)	Second Quarter 2005[3] ($)	2001–2005 % Change	Fourth Quarter[1] 2001 ($)	Second Quarter 2002 ($)	Second Quarter 2005[3] ($)	2001–2005 % Change
Lincoln	292	332	--	--	400	388	--	--	315	304	--	--	158	163	--	--
Lincoln-Afton[7]	NR	NR	496	--	NR	NR	727	--	NR	NR	476	--	NR	NR	208	--
Lincoln-Kemmerer[7]	NR	NR	379	--	NR	NR	407	--	NR	NR	374	--	NR	NR	178	--
Sublette	441	534	699	58.5%	613	655	882	43.9	350	457	590	68.6%	175	165	240	37.1%
Sweetwater	390	392	512	31.3.5	533	516	673	26.3%	422	422	594	40.8%	201	197	214	6.5%
Wyoming average	430	443	504	17.2%	599	617	693	15.7%	436	448	505	15.8%	178	183	203	14.0%[1]

[1] Source for 2001–2002 data: WDAI (2003b). Reported average rental rates may not accurately reflect actual rates within particular communities (e.g., Pinedale) that have already been impacted by other projects (e.g., Pinedale Anticline Project) in the area.
[2] Source for 2005 data: WDAI (2005c).
[3] NR = Not Reported.
[4] Two-bedroom, unfurnished, excluding gas and electric.
[5] Two or three-bedroom, single family, excluding gas and electric.
[6] This price reflects total monthly rental expense, including lot rent.
[7] Single-wide, including water.
[8] Starting in 2003 the Wyoming Cost of Living report began including Afton in Lincoln County in the comparative index. 2001 and 2005 percent change was calculated using the Lincoln 2001 figures and the Lincoln-Afton and Lincoln-Kemmerer 2005 figures.

Table 3.30. Second Home Housing Units, Wyoming and Lincoln, Sublette, and Sweetwater Counties, 1990–2000[1]

Area Name	1990 Total Housing Units	1990 Second Home Units	2000 Total Housing Units	2000 Second Home Units	2000 % Second Homes	Change 1990–2000
Wyoming	203,411	9,468	223,854	12,389	5.5%	30.9%
Lincoln County	5,409	621	6,831	912	13.4%	46.9%
Sublette County	2,911	747	3,552	930	26.2%	24.5%
Sweetwater County	15,444	137	15,921	243	1.5%	77.4%

[1]Taylor and Lieske (2002b).

According to a November 4, 2005, Casper Star Tribune article, housing in Sweetwater County is inadequate for the current demand for two reasons: (1) housing in the county is not readily available, and (2) housing currently on the market is expensive (Gearino 2005). In the second quarter of 2005, the average rental cost in Sweetwater County was $512 for apartments (up 31.3% from the fourth quarter of 2001); $673 for houses (up 26.3%); $594 for mobile homes (up 40.8%); and $214 for mobile home lots (up 6.5%) (see Table 3.29). To help meet the demand for new housing, the Sweetwater Economic Development Association has made housing development a priority for the county, and it is anticipated that 500 new housing units will be constructed in the county by next year (Gearino 2005).

3.4.4 Social Traditions

The study area's general heritage is based on ranching and mineral extraction and remains one of least populated and most undeveloped areas in the lower United States, with a population density ranging from 1.2 people/square mile in Sublette County to 3.6 people/square mile in Sweetwater County (see Table 3.24). Landownership is largely public (80% of Sublette County, 79% of Lincoln County, and 72% of Sweetwater County). Oil and gas has played a significant role in the regional economy since the 1920s. Historically, most of the oil and gas activity was limited to the LaBarge area in southwestern Sublette County and neighboring Lincoln County but now extends over much of the southern portion of the county.

The social characteristics throughout the study area are similar to other small rural western communities and are strongly tied to traditional natural resource-based industries such as agriculture and extractive industries. In addition, study area residents recognize the importance of public lands in providing a natural resource base for economic activities, as well as supporting a particular way of life. Public lands often provide scenic beauty, wildlife habitat, and recreational opportunities. Because public lands comprise 76% of all land within the study area, management decisions can affect lifestyles, as well as the economic base.

Agriculture has provided the historical basis for community development for much of the nineteenth century, and ranching and grazing are viewed as a viable economic activity that provides open space, protection of natural resources, and support of cultural and ecological diversity. Although agricultural activities have become much less important economically in recent years (providing 0.7% of industry income and 4.7% of employment in the study area in 2000), the industry is important for its historic and cultural influence. Moreover, because management decisions made by the federal land managers affect ranching operations beyond public land boundaries, residents are concerned about the social influences these decisions have on local communities.

The oil and gas industry has also played a strong role in the social character of Sublette County and has been an important part of the tax base for Sublette, Sweetwater, and Lincoln Counties for nearly 50 years. The area has experienced several boom and bust cycles throughout its history and has realized an increased population tied to this industry. Individuals working in this industry are now active members of local communities and are directly affected by federal land management decisions.

In spite of the traditional social characteristics, there are indications that the views and beliefs of residents in the study area are changing. Some areas have seen an increase in population, including a combination of retirees and others attracted to this region for the abundance of high-quality air, water, and land resources that offer a rich quality of life and reflect a western wilderness heritage. This new population is not tied to traditional natural resource industries and is more likely to support a conservation-oriented public land management policy.

3.4.5 Quality of Living

Data on quality of living for each county in the study area were obtained from the WDAI (2002b, 2005c), and the Wyoming Attorney General Office (1999, 2000, 2001, 2002, 2003, 2004). Due to the remote and unique area encompassed by the JIDPA, the United States in not included in the quality of life analysis, with the exception of crime statistics.

3.4.5.1 Crime

The Wyoming Attorney General, Division of Criminal Investigation (DCI) produces annual reports on crime statistics for the State of Wyoming. Crime data are complied from the Uniform Crime Reporting (UCR) records submitted to the DCI by law enforcement agencies across the state. In 2004, 64 individual law enforcement agencies contributed UCR data that work in jurisdictions representing 97.6% of the state's population. The intent of the UCR program is to gather relevant standardized data at the city, county, and state levels for use in compiling and analyzing national crime statistics (Wyoming Attorney General 2004).

The UCR program defines crime rates as representing the number of crimes in relation to a population of a given jurisdiction (Wyoming Attorney General 2004). As such, crime rates are often used to compare crime in different areas. Serious offenses reported in UCR data are categorized as violent crimes (murder, forcible rape, robbery, and aggravated assault) or as property crimes (burglary, larceny theft, and motor vehicle theft) (Wyoming Attorney General 2004). Crime rates are calculated by dividing the number of offenses by the population and multiplying the result by 100,000. Census estimates for 2004 were used as the base population figures for calculating crime rates.

According to the U.S. Justice Department, the national crime rate of violent offenses in 2004 was 465.5 arrests per 100,000 residents; the national crime rate for property crime was 3,517.7 per 100,000 residents (U.S. Justice Department 2004). Compared to national crime rates, Wyoming had a lower crime rate for both violent crimes (228.6) and property crimes (3,352.0) in 2004 (Wyoming Attorney General 2004).

Based on information provided in UCR annual reports, crime rates for both violent and property crimes were calculated for Lincoln, Sublette, and Sweetwater Counties. Lincoln County had a violent crime rate of 256.0, higher than the state crime rate but lower than the national crime rate. The county's property crime rate of 1,305.5 was lower than both the state and national rate. Sublette County had a violent crime rate of 405.8 and a property crime rate of 3,531.7; both crime rates were higher than the state crime rates but lower than national crime rates. Violent and property crime rates for Sweetwater County were higher than both the Wyoming and national crime rates. Crime rates for Sweetwater County were 598.5 for violent crimes 4,558.0 for property crime.

In addition to reporting crime rate offenses, the UCR program reports arrest totals. BLM 2005 provides the number of arrests in Wyoming and in the three-county study area for 1999 to 2004. Data presented in BLM2005 were compiled from the UCR annual reports from 1999 to 2004. UCR reports arrests by the type of crime committed and the age (adult or juvenile) of the defender. According to UCR data, the number of annual total arrests in Wyoming increased by 368 between 1999 and 2004 (Wyoming Attorney General 2004). Arrest totals decreased for the majority of crimes; however, the number of arrests for aggravated assault, burglary, drug offenses, and driving under the influence increased.

Overall arrests in Lincoln County decreased from 435 in 1999 to 347 in 2004. In 2004, crimes associated with the greatest number of arrests were driving under the influence (112), drug abuse violations (55), all other offenses except traffic (42), aggravated assault (35), and other assaults (17) (Wyoming Attorney General 2004).

Arrests in Sublette County increased from 257 in 1999 to 442 in 2004. Crimes associated with the greatest number of arrests were all other offenses except traffic (174), driving under the influence (110), other assaults (36), drug abuse violations (33), liquor law violation (25), and aggravated assault (14) (Wyoming Attorney General 2004).

In Sweetwater County, arrests decreased from 3,039 reported in 1999 to 2,773 reported in 2004. Crimes associated with the greatest number of arrests in 2004 were all other offenses except traffic (674), driving under the influence (364), drug abuse violations (336) drunkenness (270), and Larceny-Theft (220) (Wyoming Attorney General 2004).

3.4.5.2 Infrastructure

County and community profile information was primarily obtained from BLM (1997b) as well as local community websites and other extant information.

Lincoln County

In Lincoln County, LaBarge is the only potentially affected community. It was incorporated in 1973, LaBarge and is located in Lincoln County on U.S. Highway 189 approximately 75 miles north of Green River and 21 miles south of Big Piney. The town has a mayor/council, one full-time and one part-time policeman, 911 emergency telephone service, and a 15-member volunteer fire department. There is a 6,000-volume library, one day care center, one senior center, four churches, one motel with 36 rooms, and a recreational vehicle (RV) park with six spaces. Medical services are provided by a weekly clinic and by ambulance service, and communications include a weekly newspaper, cable TV, and a post office. Recreational facilities include one ice skating rink, two baseball fields, bike paths, two parks, and a small airport.

Sublette County

Sublette County has three airports; 26 churches; three libraries; five medical facilities (however, the nearest hospitals are in Jackson and Rock Springs, Wyoming); two museums; two newspapers; nine post offices (Big Piney, Bondurant, Boulder, Cora, Daniel, Farson, LaBarge, Marbleton, and Pinedale); and two school districts including three elementary schools, two middle schools, two high schools, and a private school, with higher education available from Western Community College's distance learning program; and utilities/services are provided by one telephone company, two garbage/refuse services, one cable television provider, three natural gas suppliers, one electricity supplier, and one coal company. Citizen organizations are important to Sublette County's infrastructure and include volunteer fire departments, a search-and-rescue organization, and a citizen's recycling program (Sublette.Com 2001, Pinedale Online 2002). The largest communities in Sublette County are Pinedale, Big Piney, Marbleton, and Boulder.

Pinedale

Located approximately 100 miles northwest of Rock Springs and 32 miles north of the JIDPA on U.S. Highway 191, Pinedale is the county seat of Sublette County. The town has a mayor/council government, 911 emergency service, and a volunteer fire department. Police protection for the town is provided through contract with the Sublette County Sheriff's Office. There is a 37,000-volume library, one day care center, one senior center, nine churches, 12 hotels/motels with a total of 244 rooms, and an RV park with 44 spaces. Medical services include a clinic, two doctors, a physician's assistant, one dentist, ambulance service, and a nursing home with 107 rooms. Communications include two weekly newspapers, cable TV, a local radio station, and a post office. There is one golf course, one ice skating rink, bike paths, two parks, and a recreation center, as well as a small airport. It has been reported that there is a shortage of health-care providers in Sublette County (Royster 2004). Some health-care providers may work shifts up to 52 hours straight. The Pinedale Medical Clinic serviced approximately 12,000 patients in 2003—mostly oil and gas workers.

Pinedale has a variety of establishments for overnight lodging. A Best Western, Amerihost Inn, and Super 8 are located on the west end of town and offer the most rooms. Several smaller motels are located in the downtown area. The surrounding area has several bed and breakfasts, guest ranches and lodges, and individual cabins available for rent. Tourism in and around Pinedale and in Sublette County in general, is a major business with the primary attraction being the natural resources in the area and the many outdoor activities associated with them, including hunting, fishing, camping, backpacking and hiking, wilderness escapes, horseback riding, mountain biking, golf, wildlife viewing, downhill skiing, cross-country skiing, and snowmobiling.

Big Piney

Big Piney is located on U.S. Highway 189 about 95 miles north of Green River and 35 miles southwest of Pinedale. The town has a mayor/council government, 911 emergency service, and a voluntary fire department. Police protection is provided by the Sublette County Sheriff's Office. There is a 40,000-volume library, one day care center, six churches, and three motels. Medical services include two doctors, one dentist, and ambulance service. Communications include a weekly newspaper, cable TV, and a post office. There is one ice skating rink, one bike path, three parks, three baseball fields, one swimming pool, and a small airport.

Marbleton

Marbleton is located on U.S. Highway 189 1 mile north of Big Piney. Marbleton has an RV park and picnic grounds, two motels, a coffee shop and restaurant, gas stations, retail shops, a movie theater, a medical clinic, and an airport.

Boulder

Boulder is an unincorporated community located on U.S. Highway 191 12 miles south of Pinedale and 85 miles north of Rock Springs. Boulder has a post office and the Boulder Store, which includes a store, gas station, RV park (nine spaces), motel (nine rooms), restaurant, and bar.

Sweetwater County

Sweetwater County is located in the southwestern part of Wyoming with 60 miles of its border touching the states of Utah and Colorado. The county consists of 10,497 square miles. The two largest cities in the county are Rock Springs and Green River.

<u>Rock Springs</u>

Established in 1888 as a mining town, the cultural tradition in Rock Springs emphasizes natural resources as the driving force behind its economy (Rock Springs Chamber of Commerce 2004). Rock Springs is located along Interstate 80 in west-central Sweetwater County and serves as the economic hub of the area. Law enforcement and fire protection services are available, as well as a 911 emergency number. Public education is provided by 11 elementary schools, two junior high schools, one high school, and Western Wyoming Community College (2-year junior college). Community services consist of two libraries (107,000 total volumes), eight day care centers, and 32 churches. Commercial services include two shopping centers, five convention facilities (with a total capacity of 4,660 persons), 31 hotels/motels (1,680 total rooms), an RV park (50 spaces), and several mobile home parks. Medical care is provided by a hospital (100 beds), a nursing home (100 rooms), 33 doctors, 24 dentists, and an ambulance service. Communications consist of two local newspapers (one published in Rock Springs and one in Green River), cable TV, two AM and three FM radio stations, and two post offices.

Recreation resources include 17 baseball fields, 24 tennis courts, six swimming pools, eight soccer fields, a golf course, one ice skating rink, two recreation centers, and 24 parks. Outdoor recreation sites available within 30 miles of the city include Flaming Gorge National Recreation Area and on BLM-administered lands, including Boar's Tusk, sand dunes, petroglyphs, and the Oregon/California Trails. Cultural/entertainment attractions include the Red Desert Rodeo, Wild Horse Days, the Sweetwater County Museum, the historical Rock Springs City Hall Museum, the Fine Arts Center, and the Western Wyoming Community College Dinosaur Collection. Rock Springs is serviced by two commercial airlines providing flights to and from the Rock Springs Airport, two bus lines, four car rental services, and two taxi services.

<u>Eden/Farson</u>

Eden and Farson are two unincorporated communities located on U.S. Highway 191 about 40 miles northwest of Rock Springs and 28 miles southeast of the JIDPA. The communities are governed by Sweetwater County and have a resident sheriff's officer and highway patrolman, a 26-member volunteer fire department, ambulance service, and 911 emergency phone service. There are four churches, two gas stations, two cafes, two bars, and a convenience store. Recreational facilities include a youth center and a county park.

Eden and Farson are not serviced by a doctor, nurse, or dentist, although there is an emergency medical technician service. The nearest medical facility is in Rock Springs. There is one elementary and one secondary school. Bridger Valley Electric supplies energy and three vendors supply propane for heating. Residents have individual wells and septic systems, and solid waste disposal facilities are available.

3.4.5.3 Cost of Living and Inflation

Cost of living and inflation information is collected by the WDAI and used to build a Comparative Cost of Living Index for each of Wyoming's 23 counties. Lincoln County ranked

18th in the state in the fourth quarter of 2002 (Table 3.31). Beginning in 2003, WDAI no longer reported cost of living for Lincoln County as whole but divided the county into a northern portion (Lincoln-Afton) and southern portion (Lincoln-Kemmerer) (WDAI 2005c). In the second quarter of 2005, Lincoln-Afton ranked fifth and Lincoln-Kemmerer ranked 17th for cost of living. Lincoln-Afton reported an all-items index of 103 and the state's fourth highest housing index of 107. Sublette County rose from the third most expensive county in Wyoming in the fourth quarter of 2002 to the second most expensive county in the second quarter of 2005 (see Table 3.31). In 2005, the county had the highest cost of living in the study area with an all-items ranking of 112, a seven-point increase from the second quarter 2002 (see Table 3.31). Sweetwater County was ranked ninth in the state in the fourth quarter of 2002 and rose to eighth in the second quarter of 2005 (see Table 3.31).

The inflation rate represents the percent change in the price level of a standard basket of selected consumer items priced this quarter, compared with the price level of the same goods recorded one year ago. WDAI (2003b, 2005c) weighted the data by population to more accurately represent the price changes experienced by the majority of consumers in Wyoming (Table 3.32). Nationally, the inflation rate from December 2001 to December 2002 was 2.4% (consumer price index for urban consumers), as reported by the Bureau of Labor Statistics (BLS). Inflation is reported only at the regional level within Wyoming. The study area is in the southwest region.

The Wyoming annual all-items inflation rate for the second quarter of 2005 was 4.5.% (see Table 3.32), with the transportation category experiencing the highest inflation rate for the second consecutive period. Inflation rates for medical ranked second overall; however, rates had decreased since the fourth quarter 2004.) Inflation is reported only at the regional level within Wyoming. The study area falls within the southwest region of the state, which consists of Lincoln, Sublette, Sweetwater, and Uinta Counties. This region had a 6.6% inflation rate in the second quarter of 2005, the highest in Wyoming, ranking higher than the state average of 4.5 and the U.S. average of 2.5(WDAI 2005c).

Because the regional inflation rates are calculated using a smaller sample size than the state-wide all items rate, they may be more volatile over time. Thus, when using the regional inflation rates, it must be noted that they can vary significantly from quarter to quarter.

3.4.5.4 Education

Detailed information on education statistics in the study area is provided in BLM (2005).

Table 3.31. Comparative Cost of Living Index for Each Wyoming County Compared with the Statewide Average of 100[1,2]

Rank	County	All Items	Food	Housing	Apparel	Transportation	Medical	Recreation and Personal Care
Fourth Quarter 2002								
1	Teton	139	105	174	121	104	110	111
2	Sheridan	106	107	107	120	100	107	104
3	Sublette	105	96	107	123	101	97	110
4	Campbell	105	100	111	87	99	101	102
5	Laramie	104	107	109	94	98	100	97
6	Johnson	103	105	100	132	100	99	106
7	Albany	102	94	107	103	101	99	96
8	Natrona	99	105	98	103	100	98	96
9	Sweetwater	98	100	95	94	100	99	103
10	Park	97	99	92	107	101	102	101
11	Carbon	94	105	85	91	102	96	107
12	Converse	94	95	90	89	100	98	98
13	Fremont	93	89	91	87	101	99	100
14	Hot Springs	93	98	83	102	102	104	103
15	Uinta	93	92	89	87	100	105	98
16	Goshen	91	93	85	99	99	97	99
17	Platte	91	100	80	107	100	95	100
18	Lincoln	91	90	84	102	100	92	99
19	Big Horn	89	96	77	117	100	95	99
20	Washakie	89	92	78	112	99	101	98
21	Niobrara	88	90	74	104	101	103	106
22	Crook	87	93	76	98	100	93	101
23	Weston	87	89	76	93	101	109	100
Second Quarter 2005								
Rank	County	All Items	Food	Housing	Apparel	Transportation	Medical	Recreation and Personal Care
1	Teton	139	104	173	127	105	111	108
2	Sublette	112	102	118	125	101	99	114
3	Sheridan	105	109	103	129	98	109	105
4	Campbell	104	103	108	98	101	95	102
5	Lincoln-Afton	103	94	107	101	101	103	106
6	Laramie	103	109	108	86	98	99	93
7	Albany	102	90	107	103	100	101	99
8	Sweetwater	102	99	104	95	101	104	98
9	Johnson	100	108	95	136	100	91	98
10	Natrona	98	99	96	100	100	95	103
11	Carbon	96	103	91	90	101	105	100
12	Park	95	100	90	101	100	103	99
13	Fremont	94	92	89	90	102	101	104
14	Converse	93	95	88	87	100	98	104
15	Uinta	93	93	90	94	99	93	94
16	Hot Springs	91	108	76	121	101	103	96

Table 3.31. (Continued)

Second Quarter 2005								
Rank	County	All Items	Food	Housing	Apparel	Transportation	Medical	Recreation and Personal Care
17	Lincoln-Kemmerer	90	89	83	100	100	88	111
18	Crook	90	92	81	112	101	94	100
19	Platte	90	100	78	105	99	106	101
20	BigHorn	89	96	77	118	100	99	102
21	Niobrara	89	94	78	109	102	101	94
22	Washakie	88	95	73	115	100	101	106
23	Goshen	88	91	78	93	99	104	96
23	Weston	86	87	76	92	100	102	99

1 Fourth quarter 2002. Prices as of January 8, 9, and 10, 2003 (statewide average = 100) (WDAI 2003b).
2 Second quarter 2005. Prices as of July 6,7, and 8, 2005 (statewide average = 100) (WDAI 2005c).

Table 3.32. Annual Inflation Rates in Wyoming by Category (Statewide Average)[1]

Quarter[2]	Category (%)						
	All Items	Food	Housing	Apparel	Transportation	Medical	Recreation and Personal Care
Weights	100.0	14.7	46.3	5.8	17.1	5.8	10.3
4Q96	4.8	9.3	2.4	7.0	7.0	4.1	2.9
2Q97	2.8	4.9	2.1	2.8	2.4	3.3	2.8
4Q97	2.9	4.5	2.5	-0.6	0.9	4.7	5.0
2Q98	1.5	2.6	0.9	3.6	0.0	0.2	3.7
4Q98	2.2	2.8	2.6	4.0	-2.2	0.7	6.2
2Q99[3]	2.6	3.7	3.2	1.1	0.7	3.0	2.3
4Q99	3.1	4.7	2.5	-0.2	4.5	3.4	3.1
2Q00	4.3	4.9	3.6	-1.2	7.9	5.2	3.3
4Q00	3.2	1.8	3.9	-0.4	2.9	4.0	3.9
2Q01	4.3	3.0	6.6	3.1	1.6	4.0	2.0
4Q01	3.5	5.0	4.5	1.8	-0.1	7.3	2.3
2Q02	2.5	1.9	3.1	0.5	-0.4	5.9	4.3
4Q02	3.7	3.3	3.1	4.5	4.7	6.0	3.9
2Q03	2.9	4.2	3.0	3.6	1.2	4.3	1.8
4Q03	3.6	5.1	5.7	2.2	-1.2	3.0	1.4
2Q04	4.9	5.2	6.3	1.8	4.8	5.0	-0.4
4Q04	4.3	4.2	4.8	0.4	5.9	5.5	0.4
2Q05	4.5	3.1	5.1	1.0	6.2	5.0	1.5

1 WDAI (2003b) was the source of data for 4Q96–2Q02; WDAI (2005c) was the source of data for 4Q02–2Q05.
2 4Q96 = fourth quarter (October, November, December) 1996. Fourth quarter represents the December to December and 2nd Quarter represents the June to June percent change.
3 The 2Q99 inflation calculations mark the first time the WCLI used all 23 counties to calculate the inflation rates. Previously, only 15 counties were used. The inflation rate represents the percent change in the price level of a standard basket of selected consumer items priced this quarter, compared with the price level of the same goods recorded one year ago.

3.4.6 Wages and Personal Income

The Bureau of Economic Analysis (BEA) reports data adjusted to current dollars using the Consumer Price Index (CPI). CPI data were obtained from the BLS (2003, 2005). CPI is a measure of the average change in prices over time in a market basket of goods and services. The estimate for 2003 was based on the change in the CPI from fourth quarter 2001 to fourth quarter 2002, and the base year was chained (i.e., three years were averaged to obtain a base year for the calculation of the CPI; e.g., 1982-1984 = 100). The BLS uses the following formula to make the calculation.

Inflation Factor = (Current Year CPI / Year “X” CPI)
Current Year Dollars = Year “X” Dollars × Inflation Factor

The CPI values and inflation factors used by EPS are listed in Table 3.33. Average wage information was obtained from BEA (2002, 2005a) and is summarized in Table 3.34. Personal income trend data were obtained from the BEA (2003b). Table 3.35 shows the components of personal income for 1980, 1990, and 2000 for the counties in the study area and Wyoming. A detailed analysis of personal income trend data is presented in BLM (2005).

Table 3.33. CPI and Inflation Factors, 1980–2004[1,2]

Year	CPI	Inflation Factor[2]	Year	CPI	Inflation Factor[2]
1980	82.4	2.09	1993	144.5	1.19
1981	90.9	1.89	1994	148.2	1.16
1982	96.5	1.78	1995	152.4	1.13
1983	99.6	1.73	1996	156.9	1.10
1984	103.9	1.66	1997	160.5	1.07
1985	107.6	1.60	1998	163.0	1.06
1986	109.6	1.57	1999	166.6	1.03
1987	113.6	1.52	2000[3]	172.2	1.00
1988	118.3	1.46	2001	177.1	0.97
1989	124.0	1.39	2002	179.9	0.96
1990	130.7	1.32	2003	184.0	.94
1991	136.2	1.26	2004	188.9	.91
1992	140.3	1.23			

1 Obtained from BLS (2003).
2 Obtained from BLS (2005)
3 Inflation Factor = CPI current year/year "X" CPI.
4 2000 is the current year (base year) for the purposes of this analysis (i.e., inflation factor = 1.00--the base year when $1 is worth $1).

Table 3.34. Wages and Job Numbers

Area	Average Wage Per Job ($)[1,2]			Number of Jobs[3]		
	1980	2000	2003	1980	2000	2003
United States	29,254	34,647	37,130	114,231,200	167,283,800	167,487,500
Wyoming	32,004	26,549	29,793	279,650	328,532	342,363
Lincoln County	31,618	25,050	30,273	6,591	8,125	9,311
Sublette County	27,816	24,783	29,887	2,812	3,965	4,704
Sweetwater County	39,568	33,748	37,460	25,503	24,281	25,017

1 The employment estimates used to compute the average wage are a job, not person, count. People holding more than one job are counted in the employment estimates for each job they hold. Source: BEA (2002); source for 2003 data: BEA (2005a).
2 All national, state, and local area dollar estimates are in Year 2000 dollars, adjusted for inflation.
3 Source for 1980 and 2000 data: BEA (2003e); source for 2003 data: BEA (2005b)).

Table 3.35. Personal Income by Major Source[1]

Income Item	U.S.			Wyoming			Lincoln County			Sublette County			Sweetwater County		
	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000	1980	1990	2000
Income Source															
Labor Income (earnings from work)	3,615,178,085	4,622,364,468	6,088,880,000	9,481,940	7,530,552	9,006,059	211,327	176,954	186,814	82,942	73,132	86,531	1,079,406	833,885	883,267
Less: Personal contributions for social insurance[2]	160,889,971	267,369,815	357,843,000	(434,627)	(443,716)	(538,454)	(9,960)	(10,862)	(11,294)	(3,425)	(3,845)	(4,888)	(57,357)	(57,117)	(57,646)
Plus/minus: Adjustment for residence[3]	(948,772)	(971,013)	(1,060,000)	(160,186)	(15,830)	(33,158)	(20,687)	(7,190)	(1,374)	1,112	2,897	4,546	(68,086)	(76,827)	(50,302)
Equals: Net earnings by place of residence	3,453,339,342	4,354,023,640	5,729,977,000	8,887,127	7,071,006	8,434,447	180,680	158,902	174,146	80,629	72,184	86,189	953,963	699,941	775,319
Plus: Dividends, interest, and rent[4]	797,599,471	1,299,148,210	1,598,302,000	1,941,106	2,512,872	3,770,663	41,514	56,371	93,968	28,756	36,812	62,205	109,813	139,622	238,493
Plus: Transfer payments	584,706,772	783,610,132	1,070,592,000	818,364	1,166,353	1,600,213	20,804	27,112	39,839	6,921	11,835	16,721	62,011	83,394	103,608
Total personal income (TPI)	4,835,645,585	6,436,781,982	8,398,871,000	11,646,597	10,750,231	13,805,323	242,998	242,386	307,953	116,306	120,831	165,115	1,125,787	922,956	1,117,420
Per capita personal income (PCPI)[5]	21,280	25,787	29,760	24,561	23,696	27,941	19,602	19,071	21,041	25,201	24,864	27,741	12,749	18,058	29,811

1 Source: BEA (2003a). Thousands of Year 2000 dollars adjusted for inflation unless otherwise noted. All national, state, and local estimates are in current dollars adjusted for inflation based on U.S. average CPI (for urban consumers). EPS uses the urban consumer base; therefore, it was also applied to inflation adjustments for this technical report to maintain consistency. EPS uses unconventional groupings for some tabular information; therefore, totals presented by EPS may vary slightly from those shown in this document.

2 Personal contributions for social insurance (e.g., Medicare) are included in earnings by type and industry but they are excluded from personal income.

3 The adjustment for residence is the net inflow/outflow of the earnings of inter-area commuters (i.e., live in Sweetwater County, work in Sublette County, net inflow to Sublette County and net outflow to Sweetwater County).

4 Rental income of persons includes the capital consumption adjustment.

5 PCPI as calculated by the BEA is not the same as personal per capita income reported by the census; therefore, they may not be identical.

3.4.7 Industry and Economy

3.4.7.1 Overview

Gross state product (GSP) is the value added to production by the labor and property located in a state (BEA 2003f). The BEA calculates GSP for a state as the sum of gross state product originating by industry of all industries. This measure of GSP is the state counterpart of the nation's gross domestic product by industry from the national income and product accounts (BEA 2003f). Further detail is provided in BLM (2005).

3.4.7.2 Wyoming Industry and Industry Employment

The BEA calculates income and gross state product information at the Standard Industrial Classification (SIC) two-digit level. The data for GSP (Table 3.36) are presented at the simplified one-digit SIC code level for the purposes of this report, with the exceptions of mining (coal, metal, and non-mineral) separated from oil and gas and government separated into federal civilian, federal military, and state and local. Table 3.37 provides employee compensation data in order to make a comparison of state-wide income growth in relation to GSP changes. Detailed analysis of Wyoming industry is presented in BLM (2005).

3.4.7.3 Industry Employment

Data were obtained from BEA regarding total annual employment by industry for the study area and for Wyoming for 1980, 1990, 2000, and 2003 to examine trends over the 20-year study period. These data are presented in Table 3.38. More detailed industry employment information for the counties as well as an analysis of industry employment for the State of Wyoming is presented in BLM (2005).

Lincoln County

All employment categories in Lincoln County added 1,534 jobs from 1980 to 2000, an increase of 23.3% (1% average annual growth) (see Table 3.38). Agriculture services, forestry, and fisheries experienced the greatest percentage of job growth (365.6%; 8% average annual growth) during the 20-year study period. The greatest number (-842) and highest percentage (-62.0%; -5% average annual loss) of job losses occurred in mining from 1980 to 2000. From 2000 to 2003, 1,186 new jobs were added (4.8% average annual growth), with construction providing the largest number of those new jobs (763) and 17.5% of all jobs in Lincoln County. The largest number of jobs (-406) was lost in retail trade, while the highest percentage of job loss (-61.7%) was in the transportation, communication, and public utilities (TCPU) sector.

Sublette County

Industry employment in Sublette County added 1,153 new jobs from 1980 to 2000, an increase of 41.0% (2% average annual growth) (see Table 3.38). Agriculture services, forestry, and fisheries experienced the greatest percentage of growth (388.9%; 8% average annual growth) during the 20-year study period. The greatest number (-68) and highest percentage (-38.6%; -2% average annual loss) of job losses occurred in TCPU from 1980 to 2000. Between 2000 and 2003, 739 new jobs were added in Sublette County (6.2% average annual growth). Mining accounted for the largest increase in the number of jobs (320), providing 13.7% of all jobs in Sublette County.

Table 3.36. Wyoming Gross State Product[1]

Industry	Gross State Product (GSP)						Growth (%)		
	1980		1990		2000				
	GSP	% of GSP	GSP	% of GSP	GSP	% of GSP	1980–1990	1990–2000	1980–2000
Agriculture	619	2.7	510	2.9	468	2.4	-17.6	-8.2	-24.3
Mining (metal, coal, non-mineral)	3,162	14.0	1,920	10.9	1,437	7.5	-39.3	-25.1	-54.6
Oil and Gas	6,499	28.8	4,215	23.8	3,089	16.2	-35.2	-26.7	-52.5
Construction	1,601	7.1	573	3.2	1,015	5.3	-64.2	77.1	-36.6
Manufacturing	917	4.1	779	4.4	1,335	7.0	-15.1	71.4	45.5
TCPU	2,236	9.9	2,661	15.0	2,510	13.1	19.0	-5.7	12.2
Wholesale Trade	802	3.6	505	2.9	773	4.0	-37.1	53.2	-3.7
Retail Trade	1,273	5.6	1,053	6.0	1,403	7.3	-17.3	33.3	10.2
Finance, Insurance, and Real Estate	2,023	9.0	1,648	9.3	2,285	12.0	-18.5	38.6	13.0
Services	1,500	6.7	1,505	8.5	2,202	11.5	0.3	46.4	46.8
Government									
Federal Civilian	391	1.7	427	2.4	501	2.6	9.2	17.4	28.2
Federal Military	196	0.9	246	1.4	277	1.4	25.4	12.4	41.0
State and Local	1,312	5.8	1,650	9.3	1,817	9.5	25.7	10.2	38.4
Total Gross State Product	22,532	100.0	17,690	100.0	19,112	100.0	-21.5	8.0	-15.2

[1] Source: BEA (2003f), millions of Year 2000 dollars, adjusted for inflation.

Table 3.37. Compensation of Employees

Industry	Compensation Paid to Employees ($000,000) from Gross State Product (GSP)[1]						Growth (%)		
	1980		1990		2000				
	Paid	% of Total Paid	Paid	% of Total Paid	Paid	% of Total Paid	1980–1990	1990–2000	1980–2000
Agriculture	148	1.7	100	1.5	132	1.6	-32.5	31.8	-12.4
Mining (metal, coal, nonmetallic)	1,220	14.0	655	9.6	518	6.4	-46.3	-20.9	-135.6
Oil and Gas	1,014	11.6	426	6.3	580	7.2	-58.0	36.3	-74.8
Construction	997	11.4	402	5.9	642	7.9	-59.7	59.8	-55.3
Manufacturing	422	4.8	364	5.3	461	5.7	-13.9	26.8	8.4
TCPU	932	10.7	780	11.5	762	9.4	-16.3	-2.3	-22.3
Wholesale Trade	416	4.8	250	3.7	299	3.7	-39.8	19.4	-39.1
Retail Trade	775	8.9	622	9.1	799	9.9	-19.8	28.5	3.0
Finance, Insurance, and Real Estate	255	2.9	237	3.5	308	3.8	-7.0	29.9	17.2
Services	832	9.5	895	13.2	1,393	17.2	7.6	55.7	40.3
Government									
Federal Civilian	380	4.4	398	5.9	443	5.5	4.6	11.3	14.1
Federal Military	173	2.0	217	3.2	226	2.8	25.3	4.0	23.3
State and Local	1,166	13.4	1,455	21.4	1,547	19.1	24.7	6.4	24.6
Total Gross State Product	8,731	100.0	6,798	100.0	8,108	100.0	-22.1	19.3	-7.7

[1]Source: BEA (2003c), Year 2000 dollars adjusted for inflation.

Table 3.38. Employment by Industry[1]

Industry	Number of Jobs															
	Lincoln County				Sublette County				Sweetwater County				Wyoming			
	1980	1990	2000	2003	1980	1990	2000	2003	1980	1990	2000	2003	1980	1990	2000	2003
Farm employment	851	733	698	671	429	402	412	385	266	220	205	197	14,504	12,476	12,624	12,192
Agriculture services, forestry, fishing and other	32	77	149	100	27	83	132	99	48	81	188	(D)	2,016	3,353	5,769	3,155
Mining (coal, metal, nonmetal, oil and gas)	1,359	667	517	642	276	315	325	645	7,318	4,989	3,717	(D)	38,523	20,840	19,387	20,881
Construction	575	444	863	1,626	388	261	427	502	3,282	1,533	1,509	(D)	25,805	15,782	24,879	27,544
Manufacturing	467	614	530	345	31	(D)[2]	91	(D)	494	745	1,649	1,232	10,512	11,203	13,583	10,940
TCPU	503	568	582	223	176	145	108	116	2,208	1,987	1,785	1,173	19,169	16,583	17,084	14,070
Wholesale trade	196	80	133	(D)	25	(D)	55	16	773	648	615	(D)	10,055	7,633	8,812	8,000
Retail trade	821	1,083	1,389	983	499	409	603	461	3,743	3,739	4,447	2,946	43,998	47,252	57,824	39,577
Finance, insurance, and real estate	287	307	471	601	147	184	228	284	693	1,125	1,127	1,304	16,334	17,167	21,303	23,367
Services	576	1,040	1,278	1,785	395	599	905	977	3,605	3,760	4,749	5,133	48,437	61,294	83,161	110,728
Federal, civilian	117	146	110	127	62	91	96	107	304	262	266	250	7,539	7,589	7,400	7,482
Federal, military	63	75	84	84	39	28	41	41	214	228	215	206	6,335	6,311	6,204	6,349
State government	109	136	126	133	54	74	72	(D)	203	278	269	287	10,988	13,150	13,820	14,570
Local government	635	903	1,195	1,299	264	364	470	(D)	2,352	3,261	3,540	3,463	25,435	31,838	36,682	38,706
Total full-time and part-time employment	6,591	6,873	8,125	9,311	2,812	2,955	3,965	4,704	25,503	22,856	24,281	25,017	279,650	272,471	328,532	342,363

1 Source: BEA (2003e).

2 (D) = not shown to avoid disclosure of confidential information, but the estimates for this item are included in the totals. BEA does not provide this information.

The retail trade sector experienced the largest decline in jobs (-142), and wholesale trade experienced the great percentage of job loss (-70.9%)

Sweetwater County

Industry employment in Sweetwater County lost 1,222 jobs from 1980 to 2000, a decrease of 4.8% (0.2% average annual decrease) (see Table 3.38). Agriculture services, forestry, and fisheries experienced the greatest percentage of growth (291.7%; 7.1% average annual growth) during the 20-year study period. The greatest number (-3,601) and highest percentage of job losses (49.2%; 3.3% average annual loss) occurred in mining from 1980 to 2000.

Between 2000 and 2003, 736 new jobs were added (1.0% average annual growth), with the services sector providing the greatest number of those new jobs (384) and 20.5% of all jobs in Sweetwater County. The greatest number (-1,501) and highest percentage of job losses (-33.8%; -11.3% average annual loss) occurred in retail trade.

3.4.7.4 Industry Earnings

Wyoming

Wyoming experienced a loss in total gross earnings for all industries (private non-farm, farm, and government) of 5.0% from 1980 to 2000 (Table 3.39). In 1980, total mineral extraction was the largest source of industry earnings in Wyoming (25.0%), and government (federal civilian, military, state, and local government) provided 17.4% of income. Mining (metal, coal, nonmetallic) led the individual categories (13.4% of all income) in 1980, followed by services (12.5%), construction (11.9%), oil and gas extraction (11.6%), and transportation, communication, and public utilities (9.8%) (see Table 3.39).

Wyoming's mining and minerals sector contributes more to GSP than any other sector of the economy (Foulke et al. 2001). Minerals (including oil and gas) accounted for 23.7% of Wyoming's GSP, or over $4.5 billion in 2000 (see Table 3.36), and supported approximately 19,387 full-time wage earners, or 5.9% of Wyoming's employment base (see Table 3.38) (BEA 2003e).

In 2000, government led industry income, providing 23.4% of income, followed by services (20.0%), retail trade (9.3%), construction (8.5%), and transportation, communication, and public utilities (8.3%) (see Table 3.39).

In real terms, for the 20-year study period, Wyoming industry income fell in farm; mining; oil and gas; construction; transportation, communication, and public utilities; wholesale trade; and retail trade. The most industry income growth occurred in non-farm agricultural services (156.4%; 4.8% average annual growth) and government (27.5%; 1.2% average annual growth) (see Table 3.39) (BEA 2003e).

Lincoln County

In 1980, total mineral extraction was the greatest source of industry income (36.4% of all income) in Lincoln County (see Table 3.39). In 2000, total government led industry income (23.4%). Total mineral extractions provided 14.2% of industry income. Over the 20-year study period (1980–2000), non-farm agricultural services led industry growth (188.1%; 5.4% average annual growth). Losses occurred in total mineral extraction (-65.4%), and farm income (-60.0%).

Table 3.39. Earnings by Industry[1]

	Wyoming						Lincoln County						Sublette County						Sweetwater County					
	1980		1990		2000		1980		1990		2000		1980		1990		2000		1980		1990		2000	
	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%	Thousands of $	%
Farm[2]	179,991	1.9	191,042	2.5	95,760	1.1	6,685	3.2	5,559	3.1	2,675	1.4	5,935	7.2	8,228	11.7	1,969	2.3	1,229	0.1	1,785	0.2	292	0.0
Nonfarm agricultural services, forestry, fishing, and other[3]	30,425	0.3	50,777	0.7	77,999	0.9	403	0.2	513	0.3	1,165	0.6	357	0.4	677	1.0	892	1.0	713	0.1	726	0.1	1,665	0.2
Mining (metal, coal, nonmetallic)[4]	1,265,969	13.4	637,410	8.5	589,053	6.5	56,356	26.7	28,946	16.4	15,921	8.5	50	0.1	3,043	4.3	1,720	2.0	322,982	29.9	262,370	31.5	151,984	17.2
Oil and gas extraction[5]	1,102,210	11.6	673,330	8.9	750,850	8.3	20,493	9.7	5,747	3.2	10,688	5.7	16,551	20	10,934	15.5	13,919	16.1	116,820	10.8	83,967	10.1	124,438	14.1
Construction	1,131,352	11.9	498,755	6.6	768,822	8.5	23,211	11.0	15,296	8.6	25,949	13.9	15,425	18.6	7,686	10.9	11,937	13.8	177,174	16.4	59,118	7.1	56,754	6.4
Manufacturing[5]	433,727	4.6	365,436	4.9	478,173	5.3	12,825	6.1	17,514	9.9	12,887	6.9	610	0.7	1,481	2.1	1,135	1.3	21,824	2.0	34,714	4.2	106,835	12.1
Transportation and public utilities	924,125	9.7	740,282	9.8	751,189	8.3	24,867	11.8	29,076	16.4	29,519	15.8	8,071	9.7	5,503	7.8	3,245	3.8	109,418	10.1	99,300	11.9	91,285	10.3
Wholesale trade[5]	414,417	4.4	250,765	3.3	302,921	3.4	6,654	3.1	2,038	1.2	2,289	1.2	1,003	1.2	773	1.1	913	1.1	32,990	3.1	22,068	2.6	20,396	2.3
Retail trade	875,953	9.2	695,019	9.2	840,999	9.3	16,725	7.9	15,501	8.8	16,062	8.6	9,143	11	5,823	8.3	8,061	9.3	77,068	7.1	57,889	6.9	66,061	7.5
Finance, insurance, and real estate	290,903	3.1	247,437	3.3	446,611	5.0	5,124	2.4	4,182	2.4	6,131	3.3	1,989	2.4	1,457	2.1	3,932	4.5	15,076	1.4	13,448	1.6	25,631	2.9
Services	1,180,316	12.4	1,206,898	16.0	1,796,451	19.9	11,832	5.6	14,783	8.4	19,792	10.6	11,245	13.6	10,601	15.1	18,032	20.8	109,094	10.1	73,273	8.8	105,933	12.0
Federal government, civilian	374,702	4.0	382,042	5.1	421,904	4.7	4,942	2.3	6,000	3.4	5,538	3.0	2,610	3.1	4,126	5.9	5,566	6.4	16,261	1.5	14,954	1.8	15,720	1.8
Military	164,959	1.7	206,034	2.7	215,018	2.4	508	0.2	925	0.5	1,178	0.6	792	1.0	357	0.5	904	1.0	1,735	0.2	2,834	0.3	3,016	0.3
State government	372,796	3.9	437,358	5.8	435,192	4.8	4,017	1.9	4,556	2.6	4,183	2.2	2,102	2.5	2,486	3.5	2,362	2.7	7,881	0.7	9,560	1.1	9,058	1.0
Local government	740,096	7.8	947,968	12.6	1,035,117	11.5	16,685	7.9	26,319	14.9	32,837	17.6	7,057	8.5	9,478	13.5	11,944	13.8	69,143	6.4	97,879	11.7	104,199	11.8
Total Earnings	9,481,940	100	7,530,552	100	9,006,059	100	211,327	100	176,954	100	186,814	100	82,942	100	70,402	100	86,531	100	1,079,406	100	833,885	100	883,267	100

[1] Source: BEA (2003a). Thousands of Year 2000 dollars, adjusted for inflation.
[2] Farm income consists of proprietors' income; the cash wages, pay-in-kind, and other labor income of hired farm workers; and the salaries of officers of corporate farms.
[3] "Other" consists of wage and salary disbursements to U.S. residents employed by international organizations and foreign embassies and consulates in the United States.
[4] Calculated by subtracting oil and gas extraction from total mining.
[5] Oil and gas extraction for Sublette County in the year 2000 was not disclosed. Therefore, the value shown was estimated for the year 2000 using the constant share of total method based on the average of the shares for 1980 and 1990 and is likely underestimated for 2000 given known increases in this sector during that period. The same method was used to estimate manufacturing and wholesale in Sublette County in 1990 based on the average of the shares for 1980 and 2000.

Sublette County

In 1980, total mineral extraction provided 20.0% (oil and gas provided 20.0%, mining provided less than 0.1%) of Sublette County industry earnings (see Table 3.39). In 2000, total government provided the most industry income to Sublette County (24.0%). Industry income in Sublette County grew during the 20-year study period from 1980 to 2000 by 4.3% (0.2% annual average growth). Mining (metal, coal, nonmetallic) in Sublette County demonstrated a boom/bust cycle, going from an average annual growth rate of 50.8% from 1980 to 1990 to a declining average annual rate of 5.5% from 1990 to 2000; thus, while the industry overall grew by 3,340.0% (19.3% annual average growth) over the 20-year study period, it provided only 2.0% of all Sublette County industry earnings in 2000. Overall, mineral extraction provided a total of 18.1% of all Sublette County industry earnings in 2000 compared to 20.0% in 1980—an average annual loss of 0.3%.

Sweetwater County

In 1980, total mineral extraction provided 40.7% (mining provided 29.9% and oil and gas provided 10.8%) of Sweetwater County industry earnings (see Table 3.39). In 2000, total mineral extraction provided 31.3% (oil and gas provided 14.1% and mining provided 17.2%) of Sweetwater County industry earnings. Total earnings in Sweetwater County fell 18.2% (1.0% annual average loss) over the 20-year study period.

3.4.8 Taxes and Revenues

The minerals industry accounts for a substantial share of revenues to the state and to local governments in Wyoming. Revenues that contributed to the general fund, including those from the minerals industry, from 1980 to 2004 are listed in Table 3.40.

Produced minerals are classified as personal property, and mineral producers pay two types of taxes: (1) the county property (ad valorem) tax on production and (2) the state severance tax. Producers pay county property (ad valorem) taxes on plants, refineries, mining and well head equipment, pipelines, and other facilities used in the mineral production and transportation operations. Mill levies applied against mineral facilities and structures are the same as those applied against all other property in the taxing jurisdiction. Property associated with mineral production is classified as industrial property and thus has a higher assessment ratio than commercial, agricultural, or residential property.

Mineral producers also pay royalties, bonuses, rentals, and fees to the owner of the mineral for the right to obtain a lease and produce the mineral. For minerals owned by the federal government, the federal government receives a share of the revenues from the mineral production, or annual rentals are paid on mineral leases that are not producing. The same is true for minerals owned by the state government. Additionally, the state receives a share of federal royalty payments for federal minerals through a federal revenue-sharing provision.

To obtain a mineral lease from the state or federal government, the lessee must pay a bonus. This “bonus” is the amount that the successful winner of the lease (i.e., highest bidder) pays to acquire the lease. The state retains the entire bonus bid to acquire state leases. One-half of the federal lease bonus proceeds for federal land leases are returned to the state.

Table 3.40. Wyoming General Fund Revenues, Fiscal Year Collections by Source[1]

Fiscal Year	Ad Valorem (Production)	Severance Tax	Sales & Use Tax	PWMTF Income	Pooled Income[2]	Charges-Sales and Services	Franchise Tax	Revenue from Others[3]	Penalties[4]	Federal Aid and Grants	All Other[5,6]	Total
1980	12,907,248	79,282	245,683	25,061	30,410	31,495	15,746	10,131	1,491	9,464	21,444	13,377,455
1981	15,367,554	90,952	267,396	34,650	29,553	31,587	16,067	7,943	2,056	9,826	20,182	15,877,767
1982	14,162,407	201,201	293,965	46,613	37,622	17,129	10,296	13,356	2,304	2,806	21,938	14,809,638
1983	13,737,084	190,796	224,897	78,946	53,131	16,971	15,007	16,229	2,788	442	40,612	14,376,904
1984	13,903,877	181,963	200,116	93,578	48,802	15,005	14,169	13,363	1,976	3,840	29,000	14,505,689
1985	12,532,055	182,560	196,486	108,030	52,254	13,681	14,484	18,681	2,501	3,858	42,055	13,166,647
1986	9,384,099	169,940	196,322	113,788	57,582	17,242	18,627	14,206	1,273	707	26,932	10,000,718
1987	8,934,607	104,407	154,576	112,297	36,053	15,142	30,329	21,040	1,432	1,273	31,046	9,442,200
1988	8,340,254	96,495	150,859	105,738	25,878	14,398	15,197	11,271	1,181	756	22,310	8,784,337
1989	8,435,621	90,777	138,466	98,671	21,377	15,829	14,580	13,149	1,691	1,406	20,005	8,851,573
1990	8,415,025	97,318	134,719	113,515	67,982	13,997	14,336	9,724	3,642	977	22,153	8,893,390
1991	7,653,645	99,741	140,803	119,046	50,717	13,195	16,843	10,913	4,386	3,244	22,080	8,134,614
1992	7,579,071	83,109	142,873	113,807	66,214	16,555	15,162	14,060	5,093	5,504	14,362	8,055,810
1993	7,497,211	78,431	149,419	105,277	31,049	17,424	15,267	10,088	3,938	8,781	12,857	7,929,742
1994	7,240,946	75,800	217,771	99,976	26,045	17,785	14,739	16,551	5,381	9,062	38,561	7,762,616
1995	7,257,937	63,816	236,956	96,731	30,693	18,128	15,593	4,600	10,779	11,944	13,641	7,760,818
1996	7,842,694	67,661	229,365	94,964	29,839	18,286	13,759	4,389	2,203	12,194	15,166	8,330,520
1997	7,983,933	76,075	230,870	98,944	25,997	19,093	14,439	5,577	6,010	12,731	13,225	8,486,894
1998	7,422,008	73,484	247,974	106,994	24,687	19,197	14,073	6,317	7,148	11,153	17,499	7,950,534
1999	8,162,297	60,905	242,616	110,437	26,174	21,017	11,823	7,245	6,070	10,639	20,143	8,679,364
2000	10,542,096	83,616	262,339	117,485	26,192	18,799	13,629	14,830	5,809	8,189	64,712	11,157,696
2001	10,860,274	135,256	288,143	94,684	33,886	20,001	14,614	9,807	6,430	10,643	20,712	11,494,450
2002	9,897,515	112,170	299,678	86,637	27,869	19,966	16,368	7,210	6,088	8,498	26,159	10,508,158
2003	12,802,262	139,958	281,654	54,887	17,982	19,155	18,341	7,673	9,482	9,911	25,580	13,386,885
2004	Not Available	168,106	297,749	89,437	26,178	22,116	19,823	4,846	8,233	10,622	31,620	-
Total Growth (%) (1980–2000)	-18.32	5.47	6.78	368.79	-13.87	-40.31	-13.45	46.39	289.74	-13.48	201.77	-16.59
Average Annual (%)	-1.01	0.27	0.33	8.03	-0.74	-2.55	-0.72	1.92	7.04	-0.72	5.68	-0.90
Total Growth (%) (2000–2004)	-	101.0	13.5	-23.9	-0.5	17.6	45.4	-67.3	41.7	29.7	51.1	-

1 Source: Consensus Revenue Estimating Group (CREG) (2003, 2005). In thousands of Year 2000 dollars, adjusted for inflation.
2 Pooled income revenues earned on water development funds were no longer distributed to the General Fund beginning in FY93.
3 In FY94, this category received an additional $2.9 million in interest on severance tax protests. The rest of the difference in this series between FY94 and FY95 is primarily because revenues from Workers' Compensation ($6.8 million in FY94) and the Retirement System Board's Trust & Agency Fund ($0.8 million in FY94) no longer flowed into the General Fund beginning in FY95. However, the expenditure responsibilities were also shifted away from the General Fund at that time. Consequently, there was no net loss in actual General Fund revenues as a result of these changes.
4 Total revenues in this category in FY95 included $4.1 million in severance tax penalty and interest and interest received during the Generally Accepted Accounting Principles transition period and an additional $2.8 million from an oil audit settlement.
5 This category includes all 1200 series tax revenue, except sales and use taxes, inheritance tax (revenue code 1401), license and permit fees (2000 revenue series), property and money use fees (4000 revenue series, excluding investment income), and non-revenue receipts (9000 revenue series). The inheritance tax total for FY94 included $21.0 million in revenue from a single estate settlement, and in FY00 it totaled $45.1 million.
6 Inheritance taxes will provide revenue to the general fund at diminishing rates through FY05. Due to federal legislation, the tax will be completely phased-out by FY06.

A severance tax is an excise tax imposed on the present and continuing privilege of removing, extracting, severing, or producing any mineral in Wyoming. Severance taxes are distributed according to Wyoming Statute (WS) 39-14-801. Severance distributions to all Wyoming counties and cities and to those counties and cities in the study area are summarized in Table 3.41. Further detail is provided in BLM (2005).

The Permanent Wyoming Mineral Trust Fund (PWMTF) is a fund that holds 25% of all severance taxes currently received by the state, functioning like a savings account for the state. The fund balance was $1.9 billion in June 2002 (Lummis et al. 2002). As reported by Lummis et al. during the previous fiscal year, over $74 million in severance taxes were added to the fund. Natural gas alone contributed 46.8% of severance taxes or more than $34.7 million to the PWMTF. Gas, oil, and associated products contributed more than $45.5 million (61.4%) of all severance added to the PWMTF. The principal of the PWMTF is inviolate but may be loaned to political subdivisions. The interest on the PWMTF goes to the state's general fund for the legislature to allocate to current programs.

Royalties

A mineral royalty is the amount of money the owner of the mineral resource receives as a payment or royalty from the mineral producer. Wyoming receives a base royalty of 16.7% of the value of production from state-owned minerals. The federal government receives a royalty of 12.5% of the value of production for minerals produced on federal lands. Fifty percent of federal mineral royalties are returned to the state, and a portion of that is then distributed to counties and cities. Unlike severance taxes, royalties are based on the value of production and byproducts. Gas and oil prices skyrocketed in 2000, bringing with them significant increases in all forms of mineral revenue along with increasing natural gas revenues, which include coalbed methane production. Natural gas prices rose in 2000 due to tighter supplies, lower storage stocks, and market perceptions (Energy Information Administration 2001). In the late 1990s, these sources of income were declining as prices for gas and oil were depressed. With renewed market pressure in late 1999, the value of production increased, as did corresponding taxes. Federal royalties are distributed by the State of Wyoming according to W.S. 9-4-601. Federal royalty distributions to all counties and cities, and those cities in the project-affected area are shown in Table 3.42. State mineral royalties received are presented in Table 3.43.

Payments in Lieu of Taxes (PILT)

The federal government owns and manages 49% of Wyoming lands. Federal lands are not subject to property taxes that support county governments and education. In 1976, Congress authorized federal land management agencies to share income with states and counties and provided a payment in lieu of taxes (PILT) program to help offset lost tax revenue (31 USC. 6901–6907 [Public Law 103-397, October 22, 1994; Public Law 104-333, November 12, 1996; and Public Law 105-83, November 14, 1997]; 43 CFR Part 1880 [65 FR 51229–51234, August 23, 2000, effective September 22, 2000]). PILT payments are federal payments to local governments that help offset losses in property taxes due to nontaxable federal lands within their boundaries. PILT payments are administered by the BLM (Coupal et al. 2003).

Table 3.41. Summary of Mineral Severance Taxes Received by Wyoming and Directly Distributed to All Wyoming Counties and Cities and Project-Affected Counties and Cities in the Study Area

	Distributions (Thousands of $)[1]						
Tax and Distribution Entity	1980	1990	2000	2001	2002	2003	2004
Total Received by Wyoming[2]	219,889	331,196	275,123	434,534	287,457	401,606	513,744
Amount Distributed to All Counties[2]	--	8,628	8,559	15,171	6,081	5,743	5,737
Lincoln County[3]	--	--	159	405	231	164	155
Sublette County[3]	--	--	61	159	94	63	68
Sweetwater County[3]	--	--	489	1,175	595	499	298
Amount Distributed to All Cities[2]	--	25,885	21,506	32,136	14,498	13,691	13,678
LaBarge[4]	--	--	27	53	22	18	17
Big Piney[4]	--	--	25	49	21	17	16
Marbleton[4]	--	--	35	74	37	30	29
Pinedale[4]	--	--	65	140	72	60	56
Rock Springs[4]	--	--	1,056	2,121	959	789	744

[1] In Year 2000 dollars, adjusted for inflation; -- = data not available.
[2] Source: CREG (2003, 2005). Total direct disbursements to cities and counties, not including capital construction or other funds.
[3] Sources: Lummis et al. (2000, 2001, 2002, 2003, 2004). Distributions to counties. Total distributions reported by Lummis et al. do not add to the total reported as revenue received in CREG (2003, 2005).
[4] Source: Lummis et al. (2000, 2001, 2002, 2003, 2004). Distributions to towns and cities. Total distributions reported by Lummis et al. do not add to the total reported as revenue received in CREG (2003, 2005).

Table 3.42. Summary of Federal Mineral Royalties Received by Wyoming and Directly Distributed to All Counties and Cities and Project-Affected Counties and Cities[1,2]

Tax and Distribution Entity	Distributions (Thousands of $)[3]						
	1980	1990	2000	2001	2002	2003	2004
Total Received by Wyoming[4]	198,742	222,188	309,093	434,676	334,703	447,693	504,474
Amount Distributed to Counties[4]	n/d	1,389	n/d	n/d	n/d	ND	ND
Amount Distributed to Cities[4]	--	20,830	19,588	21,678	17,820	17,449	16,892
LaBarge[5]	--	--	61	60	55	68	65
Big Piney[5]	--	--	66	64	55	67	65
Marbleton[5]	--	--	86	88	86	108	104
Pinedale[5]	--	--	147	152	154	198	190
Rock Springs[5]	--	--	1,010	1,002	994	1,622	1,533

1 Includes coal lease bonuses.
2 FY98 coal revenues include $8.0 million in protest severance taxes that were from prior production years.
3 In Year 2000 dollars, adjusted for inflation; -- = data not available; n/d = no distribution.
4 Consensus Revenue Estimating Group (CREG) (2003). Total direct disbursements to cities and counties, not including capital construction or other funds.
5 Lummis et al. (2000, 2001, 2002, 2003, 2004). Distributions to towns and cities. Total distributions reported by Lummis et al. do not add to the total reported as revenue received in CREG (2003, 2005).

Table 3.43. Summary of State of Wyoming Mineral Royalties[1]

Fiscal Year	Thousands of $[1]
1980	--
1990	--
2000	34,099
2001	56,021
2002	35,455
2003	52,821

1 Historical data for state-owned mineral royalties are not readily available and are generally not included in socioeconomic analyses prepared by Wyoming state agencies. WDAI (2002a, 2004)

PILT payments are based on three factors:

- eligible federal acres in the county,
- federal revenue-sharing going to the county the prior year, and
- county population up to the pre-determined ceiling.

Since 1998, PILT payments received by Wyoming have increased by 63.9% (Table 3.44). The three-county study area has experienced a similar increase.

Lincoln County PILT payments increased 74.2%, Sublette County payments increased 58.9%, and Sweetwater County PILT payments increased 58.0% over the past 6 years.

Table 3.44. Total PILT Payments and Total Acres[1]

Location	PILT Payments/Acres					
	1998	1999	2000	2001	2002	2003
Wyoming						
Payment ($)	8,118,173	8,208,280	8,318,110	11,828,099	12,392,400	13,304,416
Acres	29,917,112	29,893,541	29,885,632	29,884,922	29,889,764	29,877,970
Lincoln County						
Payment ($)	384,723	406,667	418,646	598,093	617,577	670,171
Acres	1,946,836	1,946,805	1,946,765	1,946,631	1,947,558	1,947,558
Sublette County						
Payment ($)	258,703	247,508	256,483	360,764	376,237	411,150
Acres	2,432,160	2,432,000	2,431,960	2,431,960	2,431,305	2,431,305
Sweetwater County						
Payment ($)	910,456	929,377	949,649	1,281,416	1,333,882	1,438,845
Acres	4,609,862	4,606,891	4,606,891	4,606,888	4,606,888	4,606,799

[1] Coupal et al. (2003) and BLM (2003c), in year 2000 dollars, adjusted for inflation.

Property Taxes (Ad Valorem Taxes)

The taxable valuation of all mineral production in Wyoming fell 18% from $12.9 billion in 1980 to $10.5 billion in 2000 (-1.1% average annual decline) (Wyoming Department of Revenue 2002). Foulke et al. (2001) believe that mineral revenues will continue to rise and that gas production, particularly, will drive future revenues higher for the foreseeable future. Assessed production values are presented in Table 3.45.

Table 3.45. Total State-Assessed Mineral Production Valuations[1]

Mineral Type	Taxable Valuation (Thousands of $)					
	1980	1990	2000	2001	2002	2003
Oil	4,847,711	2,561,672	1,438,976	1,047,618	1,068,000	1,169,559
Natural Gas	1,402,442	1,057,631	3,365,841	3,765,627	1,894,848	4,949,226
Coal	1,616,744	1,487,154	1,336,116	1,461,147	1,500,000	1,736,164
Trona	290,327	236,359	206,219	202,916	203,520	183,491
All Other Minerals	256,679	52,660	59,909	59,256	57,600	60,619
Total Mineral Taxable Valuation	8,413,904	5,395,476	6,407,060	6,536,564	4,723,968	8,099,061
Other Property	4,493,344	3,019,549	4,135,036	4,297,663	4,466,016	4,759,703
Total	12,907,248	8,415,025	10,542,096	10,834,228	9,189,984	12,858,764

[1] Consensus Revenue Estimating Group (2003), thousands of year 2000 dollars, adjusted for inflation.

Wyoming Department of Revenue reports indicate that in 2002, natural gas production contributed the greatest proportion of taxable value to the state (34.8%), followed by residential land and improvements (18.5%), mining production (15.9%), and oil production (9.7%) (Table 3.46). In 2004 natural gas production continued to contribute the greatest proportion of taxable value to the state (38.5%), again followed by residential land and improvements (17.8%), mining production (15.4%), and oil production (9.1%) (see Table 3.46).

Table 3.46. Proportionate Taxable Valuation of Various Classes of Property in Wyoming, 1998–2004

Property	Proportion of Taxable Value[1] (Ranked Highest to Lowest According to 2002 Proportions)						
	1998	1999	2000	2001	2002	2003	2004
Natural gas production	19.20%	18.60%	20.60%	31.90%	34.80%	24.30%	38.50%
Residential lands and improvements	19.90%	22.60%	22.00%	18.50%	18.50%	21.80%	17.80%
Mining (coal, minerals, and non-minerals)	20.00%	41.60%	19.50%	15.20%	15.90%	19.60%	15.40%
Oil production	14.70%	8.80%	11.50%	13.70%	9.70%	10.50%	9.10%
Industrial and manufacturing property	8.90%	9.80%	8.70%	7.10%	7.40%	8.10%	6.40%
Commercial lands and improvements	1.50%	5.60%	5.20%	4.20%	4.40%	4.90%	4.00%
Railroads	1.70%	2.00%	2.20%	1.70%	1.80%	2.00%	1.60%
Electric/gas-privately owned	2.50%	2.60%	2.30%	1.60%	1.60%	1.80%	1.60%
Commercial personal property	1.50%	1.70%	1.60%	1.30%	1.30%	1.60%	1.30%
Agricultural lands	1.90%	2.00%	1.80%	1.30%	1.30%	1.50%	1.30%
Natural gas pipelines	0.90%	1.10%	1.10%	0.80%	1.00%	1.20%	0.90%
Electric-cooperatives	1.50%	1.10%	1.00%	0.70%	0.60%	0.80%	0.60%
Major telecommunications	0.70%	0.70%	0.81%	0.70%	0.60%	0.50%	0.30%
Residential personal property	0.60%	0.60%	0.57%	0.40%	0.40%	0.40%	0.30%
Liquid pipelines	0.60%	0.70%	0.67%	0.40%	0.40%	0.50%	0.30%
Rural telecommunications	0.20%	0.30%	0.23%	0.20%	0.20%	0.20%	0.20%
Cellular/reseller telecommunications[2]	<0.1%	0.10%	0.16%	0.10%	0.20%	0.20%	0.10%
Airlines	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	0.05%	0.03%
Electric-municipal	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	0.06%	0.04%

[1] Columns may not total to 100% due to rounding. Source: Wyoming Department of Revenue (1998, 1999, 2000, 2001, 2002, 2003, 2004).
[2] Designated as radio-telephones in 1998.

Sales, Use, and Lodging Tax

Wyoming has had sales and use taxes since 1935. Sales taxes apply to the retail sale of personal property or services within the state. A use tax is levied on any sale of any property outside the state of Wyoming for use, storage, or consumption inside the state of Wyoming.

Wyoming counties, cities, and towns benefit from sales and use tax collections. Each month, the treasurer's office in each county sends the sales tax collections to the Wyoming Department of Revenue, which distributes the money. Currently, two-thirds of the 4% sales tax collections go to the state general fund, and one-third (minus 1% for state administrative purposes) is returned to the cities, towns, and counties. The money returned to the cities and counties is based on where the purchase occurred and the population of the city or county (which is based on the last federal census). Counties that have 1% optional sales taxes or a 1% capital facilities tax keep 100% of the additional 1% collected. The state's share of the sales tax revenue is distributed to the General Fund. Effective tax rates for the study area as of 2002 are listed in Table 3.47.

Table 3.47. Sales, Use, and Lodging Tax Rates by County (Effective April 1, 2003)[1]

Tax Rate	Lincoln	Sublette	Sweetwater
State Sales Tax Rate	4.0%	4.0%	4.0%
General Purpose Option Tax	1.0%	--	1.0%
Specific Purpose Option Tax	--	--	0.5%
Subtotal	5.0%	4.0%	5.5%
Lodging Tax	2.0%[2]	3.0%	2.0%
Total Tax Rate	7.0%	7.0%	7.5%

[1] Wyoming Department of Revenue (2003).
[2] Note: Lodging tax is imposed only in Afton (i.e., not in a county-wide base).

County sales tax rates can fluctuate from year to year because county option taxes originate and expire at varying times; therefore, only the total state imposed sales tax (4%) will be used for this analysis. State use tax is imposed on purchases made outside a taxing jurisdiction for first use, storage, or other consumption within that jurisdiction (see Table 3.47). Thus, the use tax prevents sales tax avoidance or the payment of a lesser tax rate by making purchases outside of the taxing jurisdiction where first use, storage, or other consumption will occur. Wyoming taxing jurisdictions are the State of Wyoming and/or each Wyoming county. Use tax is a complement of sales tax. Effective January 1, 1981, the adoption of an optional sales tax required a change in the use tax rate of equal amount. State use tax is shared between state government and the county of origin on the same distribution basis as sales tax. Therefore, the revised rate and allocation, as mentioned earlier in the sales tax description, applies here as well.

Cities, towns, and counties, by voter approval, may impose a lodging excise tax of up to 4% on all sleeping accommodations for guests staying less than 30 days (see Table 3.47). This tax extends to mobile accommodations such as tents, trailers, and campers, as well. All collections (less a 2% state administrative cost during the first year the tax is imposed and 1% thereafter) are distributed to the cities, towns, and counties of origin. At least 90% of the tax distributions must be used to promote travel and tourism within the county, city, or town imposing the tax. The amount remaining, not to exceed 10% of the total amount distributed, may be used for general revenue within the governmental entity imposing the tax.

3.4.9 Study Area Taxes and Revenues

3.4.9.1 Availability of Information

Reporting of tax and revenue information has evolved with the development of the internet and the ease of publishing large volumes of information; this evolution has led to an unavailability of certain reports and information that predate 1998 (Yurek pers. comm.).

Oil and gas field operations support employment in many industries. Firms whose primary activity is operating oil and gas wells, exploring for oil and gas, or providing oil and gas field services are included in SIC 13, mining--oil and gas extraction. But many employers in other industries such as wholesale trade and transportation, communications, and public utilities depend on business from oil and gas service companies (WDERP 1999). According to Bullard in WDERP (1999: Table 1 and Map 1), the Sublette and Sweetwater County economies are highly dependent on oil and natural gas extraction (15.2% and 5.8%, respectively), while Lincoln County is moderately dependent (4.2%) on the oil and gas industry.

While it is not possible to determine the proportion of funds each city and county spends on each item of infrastructure and services derived from oil and gas revenues, example budgets for Big Piney, Pinedale, and Sublette County are presented in BLM (2005). Funds received by Sublette County in recent years have been used for capital improvements, such as a new courthouse, jail, land fill, senior centers, and public clinic upgrade, and surpluses have been placed in reserve accounts to develop savings for future requirements (Langford pers. comm.). Funds received in Big Piney in excess of normal operating have also gone to capital improvements (Brown pers. comm.).

3.4.9.2 State Royalties

In total, royalties in Wyoming arising from natural gas production on state lands increased by nearly 62.0% from 1998 to 2002 (Wyoming Office of State Lands and Investments [WOSLI] 2002). Oil royalties rose and fell, but overall grew 5.6% from 1998 to 2002. Between 2002 and 2004, natural gas royalties in Wyoming increased by 148.9% and oil royalties grew 40.7% (WOSLI 2004).

In Lincoln County, royalties from natural gas production on state lands fell 21.5% from 1998 to 2002. Oil royalties have risen and fallen, but generally declined in Lincoln County, falling 17.3% from 1998 to 2002. The only other mineral royalty paid to Lincoln County in 2001 and 2002 from state lands was for sand and gravel (WOSLI 2002). Between 2002 and 2004, natural gas royalties in Lincoln County increased by 75.8%, while oil royalties decreased by 2.3% (WOSLI 2004).

In contrast, Sublette County has experienced significant increases in royalties from natural gas and oil production on state lands. Royalties from natural gas increased by 81.9% from 1998 to 2002. Oil royalties increased even more dramatically (155.9%) from 1998 to 2002. The only other mineral royalty paid to Sublette County in 2001 and 2002 from state lands was for sand and gravel (WOSLI 2002). Between 2002 and 2004, natural gas royalties in Sublette County increased by 124.4%. Oil royalties grew only 4.9% (WOSLI 2004).

Sweetwater County royalties from natural gas production on state lands increased by more than 17.1% from 1998 to 2002. Oil royalties also increased (20.6%; 3.8% average annual growth) in Sweetwater County from 1998 to 2002. Sweetwater County received most of its royalties from (and is the only county in Wyoming to receive royalties from) trona mining but also received royalties from coal (2000, 2001, 2002), limestone (2000), uranium (2002), and sand and gravel (2001, 2002). Between 2002 and 2004, natural gas royalties in Sweetwater County increased by 294%, while oil royalties decreased by 3.9% (WOSLI 2004).

3.4.9.3 Ad Valorem Valuation and Taxes Levied

Due to changes in agency reporting methods, information from 1980 and 1990 was only minimally available. Ad valorem valuations for the study area illustrating tax source and allocation are presented in BLM (2005).

3.4.9.4 Sales, Use, and Lodging Tax Collections

Sales, use, and lodging tax collection information is presented for Wyoming and the three-county study area in BLM (2005).

3.4.10 Recreation Economics

Because the JIDPA lies almost entirely within the PFO area, recreation economics are evaluated only within this area. However, some additional demand is likely in other areas (e.g., Lincoln and Sweetwater Counties). See BLM (2005) for more detailed analysis.

3.4.10.1 Nonconsumptive Recreation

Table 3.48 shows the recreational visitor days (RVDs) per activity for the PFO for a 4-year period from 1998 to 2002 (BLM 2003d). (These data are considered to be somewhat inaccurate.) During this time, over 300,000 RVDs are estimated to have occurred annually within the PFO area for a variety of activities. The most popular of these activities were float or raft trips, fishing, camping, and hiking/walking/running. Hunting is addressed separately (Section 3.4.10.2).

3.4.10.2 Hunting

Hunting is also popular within the PFO area. Much of this activity occurs on BLM-managed land because this land provides habitat for many species, including big game, small game, and upland game birds. Pronghorn is the only big game species likely to be hunted in the JIDPA; therefore, the economics of hunting other big game species are not addressed further in this EIS.

The entire JIDPA lies within the Sublette Pronghorn Antelope Herd Unit, which occupies approximately 6.7 million acres (Table 3.49). BLM is responsible for management of 64% of the surface of the Sublette Herd Unit; the USFS is responsible for management of 4% of the surface; 4% is managed by the Bureau of Reclamation; and 26% is in State of Wyoming and private ownership. Pronghorn hunting was estimated from WGFD data because WGFD regulates the sport and keeps data on hunting use by animal and by area throughout Wyoming (Table 3.50).

Table 3.48. Estimated Annual Recreational Visitor Days, PFO Area[1]

Activity	Annual Recreational Visitor Days[2]	Percent of Total Activity
Archery	760	0.24
Backpacking	4,118	1.29
Bicycling–Mountain	5,066	1.58
Bicycling–Road	16	0.01
Camping	35,168	10.99
Climbing–Mountain/Rock	458	0.14
Driving for Pleasure	4,182	1.31
Environmental Education	55	0.02
Fishing	73,227	22.89
Hiking/Walking/Running	30,581	9.56
Horseback Riding	732	0.23
Nature Study	880	0.28
Off-highway vehicles (OHVs)/All-terrain vehicles (ATVs)	1,268	0.40
OHVs – Cars/Trucks/Sport Utility Vehicles	155	0.05
Pack Trips	2,746	0.86
Photography	880	0.28
Picnicking	1,366	0.43
Power Boating	789	0.25
Row/Float/Raft	138,630	43.32
Skiing – Cross-Country	2,123	0.66
Snowmobiling	12,368	3.87
Staging/Comfort Stop	829	0.26
Swimming/Water Play	854	0.27
Viewing Wildlife	2,727	0.85
Total Recreational Visitor Days	319,978	100.00

[1] From BLM (2003d).

Table 3.49. Herd Unit and Landownership in the JIDPA[1]

Herd Unit Name	Total Acres	Ownership/Management (acres)		Disturbed within Unit (acres)
		Federal	State/Private	
Sublette Antelope Herd Unit	6,749,440	4,994,586	1,754,854	85,000

[1] Source: BLM (2004b).

Table 3.50. Summary of Hunters and Hunter-Days for Potentially Project-Affected Big Game Species in the PFO Area, 2002[1]

<table>
<tr><th rowspan="3">Species</th><th colspan="6">Wyoming</th><th colspan="6">Sublette Antelope Herd Unit [2]</th></tr>
<tr><th colspan="3">Hunters per Year[3]</th><th colspan="3">Hunter-Days per Year[3,4]</th><th colspan="3">Hunters per Year[3]</th><th colspan="3">Hunter-Days per Year[3,4]</th></tr>
<tr><th>Total</th><th>Resident</th><th>Non-resident</th><th>Total</th><th>Resident</th><th>Non-resident</th><th>Total</th><th>Resident</th><th>Non-resident</th><th>Total</th><th>Resident</th><th>Non-resident</th></tr>
<tr><td>Pronghorn</td><td>33,569</td><td>15,776</td><td>17,793</td><td>101,989</td><td>51,208</td><td>50,781</td><td>4,382</td><td>2,881</td><td>1,501</td><td>13,490</td><td>9,356</td><td>4,134</td></tr>
</table>

[1] Source: WGFD (2003a).
[2] The proposed project area is encompassed within the Sublette Antelope Herd Unit.
[3] Calculated from Harvest, Hunting Pressure, Hunter Success by Hunt Area 2002 reports for each species. Totals may not match statewide summary tables.
[4] WGFD defines a "hunter-day" as any day hunting occurred, regardless of actual time spent hunting. These data are based on licensed hunter survey reports.

<u>Furbearers, Small Game, Upland Birds, and Waterfowl</u>

Furbearers likely occur within the JIDPA, which lies within Furbearer Management Area 7 (WGFD 2003b). Weasel, badger, skunk, coyote, red fox, and bobcat are likely to occur and may be hunted/trapped in the vicinity of the project area. WGFD has not collected hunter expenditure information for these species (WGFD 2003d); therefore, they are not addressed further herein.

The JIDPA lies within Small Game Management Area 7 (WGFD 2003b); however, due to habitat limitations, only greater sage-grouse and desert cottontail rabbit are likely to occur and be hunted on the JIDPA (Table 3.51). The WGFD has not collected hunter expenditure information for all small game species that may potentially occur and may occasionally be hunted and trapped on the JIDPA (WGFD 2003d); therefore, impact analysis is provided only for desert cottontail rabbit and greater sage-grouse.

Waterfowl Area 5B encompasses the JIDPA, and ducks and geese may be hunted in the vicinity of the project area. The WGFD has not collected hunter expenditure information for all waterfowl species that may potentially occur and may occasionally be hunted on the JIDPA (WGFD 2003d); therefore, these species are not addressed further herein.

Table 3.51. Summary of Potentially Project-Affected Small Game and Upland Bird Hunters and Hunter-Days in the JIDPA, 2002[1]

Species	Total Wyoming		Area 7[2] (Eden)	
	Number of Hunters	Hunter Days	Number of Hunters	Hunter Days
Desert cottontail rabbit	5,814	25,566	316	1,981
Greater sage-grouse	2,947	7,164	271	938
Total	8,761	32,730	587	2,919

[1]WGFD (2003b).
[2]Encompasses the JIDPA in its entirety.

3.4.10.3 Value of Recreational Use

Recreational activities (nonconsumptive and hunting) have important economic value both in terms of the satisfaction provided to local residents and visitors and the economic activity it generates for the regional economy. Recreation generates additional spending in the local economy that supports jobs and income. Economic stimulus occurs as non-residents visit the area and spend money in the local economy, which in turn generates additional spending by local residents. It is assumed that if local residents were not participating in recreation, they probably would have spent their money on something else in the region's economy. Thus, expenditures by local residents are seen as a shifting of dollars from one sector to another within the local economy and not a net gain to the region. However, dollars that remain within the community when local residents have satisfactory recreational opportunities are important. Keeping dollars within the local economy helps maintain jobs, thus reducing employment and income fluctuations that may result if those dollars became an outflow from (i.e., are spent outside) the local economy.

Value of Nonconsumptive Recreation

The value of recreation was estimated using the methods developed for the South West Regional Economic Evaluation (University of Wyoming, Agricultural Economics Department [UWAED 1997]) and Jack Morrow Hills Coordinated Activity Plan (BLM 2003a, UWAED 2003). Nonconsumptive recreation was derived from UWAED (1997), and is presented in Year 2000 dollars adjusted for inflation. The estimated expenditures per day for nonconsumptive recreation in the PFO is summarized in Table 3.52.

Value of Hunting

The method used to determine the total expenditures associated with hunting is based on that used by UWAED (1997) and then updated with 2002 hunting and hunter expenditure data from WGFD (2003a, 2003b, 2003c). The data are then presented in Year 2000 dollars and adjusted for inflation. The JIDPA is fully encompassed by the Sublette Antelope Herd Unit, and for the purposes of this report it is assumed that pronghorn antelope are evenly hunted across the herd unit because it is not possible to derive from existing data exactly where any individual hunts. This method results in a conservative over-estimate of the value of hunting in a particular area because in actual practice, hunting likely does not occur evenly across all areas of a hunt unit. The total expenditures of hunting pronghorn antelope on the JIDPA is presented in Tables 3.53 and 3.54.

Table 3.52. Expenditures per day for Nonconsumptive Recreation, PFO Area, 1997[1]

Recreation Activity	Value per Visitor-Day ($)
General recreation	10.18
Developed camping	15.73
Primitive camping	19.85
Day hiking	33.01
Picnicking	14.32
Sightseeing	16.68
Gathering forest products	15.17
Wilderness recreation	14.45
Big game hunting	77.25
Trout fishing	30.04
Wildlife watching	30.04
Snowmobiling	51.50
Average value per visitor day	27.35

[1] In Year 2000 dollars, adjusted for inflation. Source: UWAED (1997).

Table 3.53. Total Expenditures for Hunting of Species Potentially Occurring in the Project Area, Wyoming and Study Area, 2002

Species	Wyoming				Average Value/ Hunter-Day ($)	Attributable to Potentially Affected Hunt Areas					
	Hunter-Days[1,2]			Hunter Expenditures[3] ($)		Hunter-Days[4]			Hunter Expenditures ($)		
	Total	Resident	Non-resident	Total		Total	Resident	Non-resident	Total	Resident	Non-resident
Antelope	101,989	51,208	50,781	38,888,895	381.30	13,490	9,356	4,134	5,143,737	3,567,443	1,576,294
Cottontail[6]	25,566	NA	NA	4,424,464	173.06	2,516	NA	NA	435,419	--	--
Greater sage-grouse[6]	7,164	NA	NA	933,437	130.30	1,553	NA	NA	202,356	--	--
Total	134,719	51,208	50,781	44,246,796	228.22	17,559	NA	NA	5,781,512	--	--

1 WGFD (2003a, 2003b). Calculated from Harvest, Hunting Pressure, Hunter Success By Hunt Area 2002 reports for each species. Totals may not match state-wide summary tables or WGFD (2003c).
2 WGFD defines a "hunter-day" as any day hunting occurred, regardless of actual time spent hunting. This data is based on licensed hunter survey reports.
3 WGFD (2003c). In year 2000 dollars, adjusted for inflation. WGFD does not distinguish between resident and non-resident expenditures.
4 Refer to Tables 3.54 and 3.55.
5 Species that may occur infrequently within the affected areas that WGFD does not manage for hunting in the project areas may include bighorn sheep, Rocky Mountain goat, black bear, and mountain lion.
6 WGFD does not separate resident and non-resident hunter days for small and upland game.

Table 3.54. Contribution of JIDPA to Hunting Revenues

Species	Unit Name	Total Acres	Hunter-Days Attributable to Unit	Average Value/ Hunter-Day ($)	Project Area (acres)	% Acres of Unit in Project Area	Hunter-Days in Project Area	Annual Value Attributable to Hunting on Project Area ($)
Antelope	Sublette Antelope Herd Unit	6,749,440	13,490	381.30	30,500	0.5%	61.0	23,244.00
Cottontail	Small Game Management Area 7	2,906,068	2,516	173.06	30,500	1.0%	26.4	4,569.84
Greater sage-grouse	Small Game Management Area 7	2,906,068	1,553	130.30	30,500	1.0%	16.3	2,123.78
Total	--	n/a[2]	n/a[2]	n/a[2]	n/a[2]	n/a[2]	103.7	29,937.63

1 In year 2000 dollars, adjusted for inflation.
2 n/a = column is not additive.

JIDPA Hunting Value

Because elk, mule deer, and moose are unlikely to occur on the JIDPA, there is no value attributable to the project area for those species. Pronghorn do occur on the JIDPA, and an estimated 61.0 hunter days (0.5% of the Sublette Antelope Herd Unit hunter days) are attributed to the JIDPA. At a value of approximately $381.30/hunter day, approximately $23,244 of hunter expenditures for antelope annually is attributable to hunting on the JIDPA. Approximately 1.0% of hunting in Small Game Management Area 7 for cottontail and greater sage-grouse each are attributable to hunting on the JIDPA. Cottontail account for 26.4 hunter days for a value of approximately $4,569.84 of hunter expenditures attributable to cottontail hunting on the JIDPA. Greater sage-grouse account for 16.3 hunter days for a value of approximately $2,123.78 of hunter expenditures attributable to greater sage-grouse hunting annually on the JIDPA.

3.4.11 Environmental Justice

Less than 5% of the Sublette County population is minority (EPA 2003) and, although 9.7% of the population of Sublette County lives below the poverty level, this is a smaller percentage than for the State of Wyoming (11.4%) (U.S. Census Bureau 2000a). Therefore, Sublette County is neither a minority community nor a low-income community.

3.5 LAND USE

3.5.1 Land Status/Prior Rights

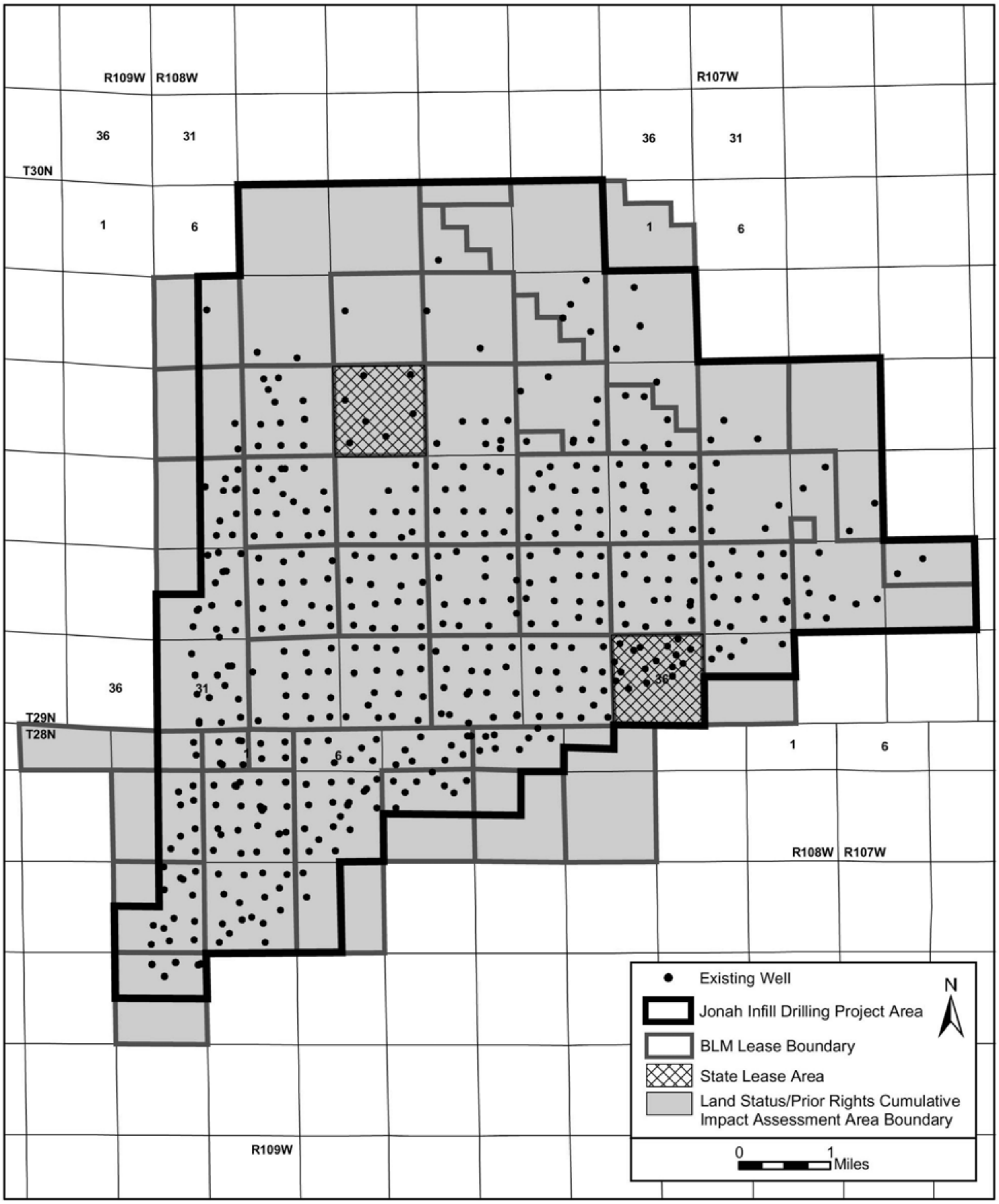
The JIDPA consists of federal surface/federal minerals administered by the BLM (94%/28,580 acres), two sections (1,280 acres) of State of Wyoming surface/mineral, and one section (640 acres) of private surface/federal minerals (see Map 1.1). Current land use includes energy production and development (e.g., natural gas well pads, pipelines, access roads, ware yards, offices), livestock grazing, wildlife habitat, and recreation—primarily hunting. Map 2.1 shows the extent of existing natural gas development in the JIDPA.

The CIAA for land status/prior rights includes the JIDPA and leases that extend beyond the JIDPA, and it encompasses approximately 35,634 acres (Map 3.21). All of the JIDPA and the CIAA is leased for mineral development. Land use associated with mineral development on the JIDPA is described in Section 3.1.4.1.

3.5.2 Livestock/Grazing Management

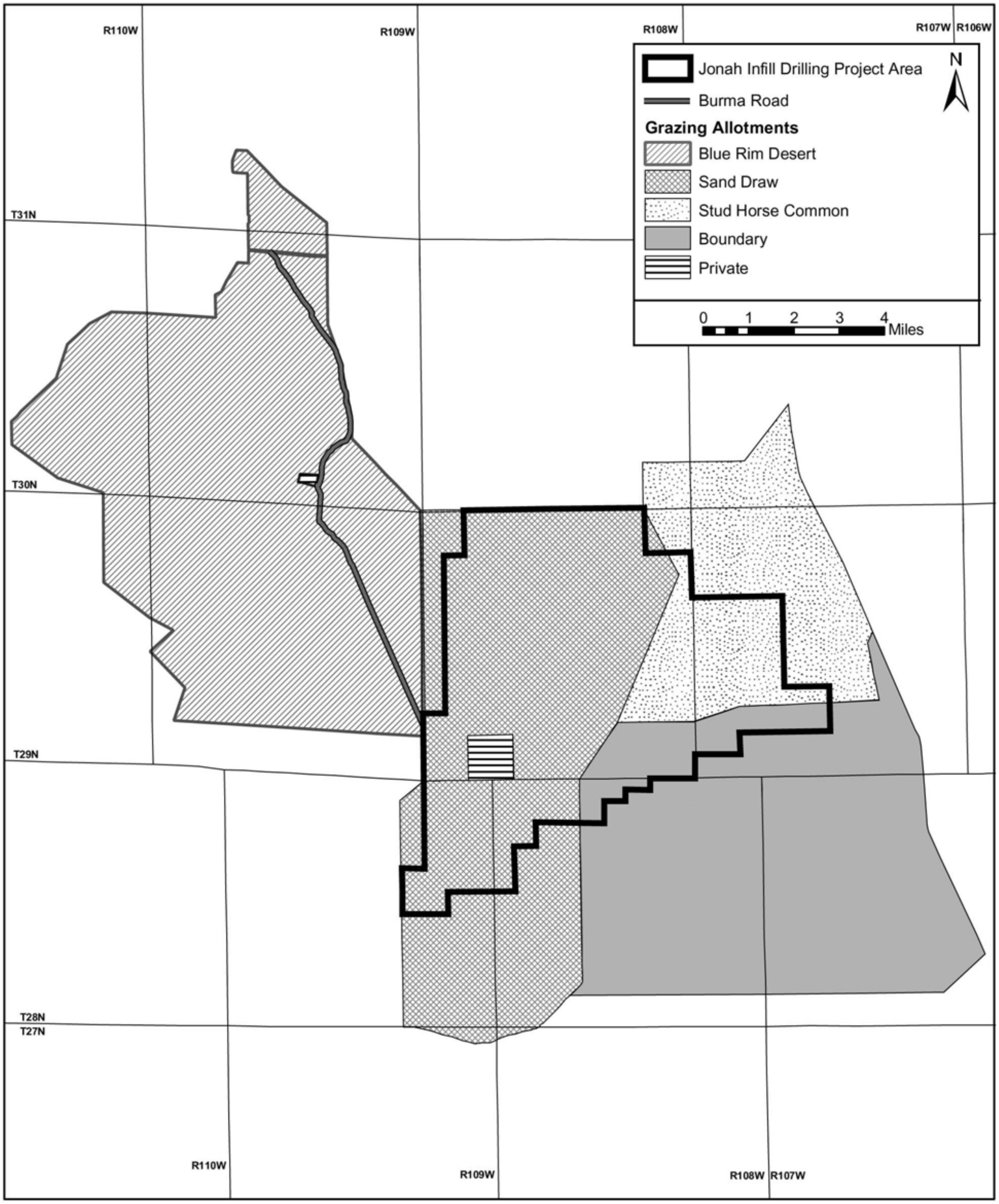
The JIDPA includes portions of three grazing allotments—Stud Horse Common, Sand Draw Common, and Boundary—and the Burma Road Upgrade area includes portions of the Blue Rim Desert Common Allotment (Map 3.22 and Table 3.55). Livestock grazing is allocated to two permittees each in the Stud Horse Common and Sand Draw Common Allotments and four permittees in the Blue Rim Desert Common Allotment. The Boundary Allotment is allocated to two permittees. There are also approximately 640 acres of private lands (2% of the JIDPA) not included in allotments (see Map 3.22).

Prior to 1997, the level of human activity in the area of the proposed action was minimal. Grazing was the major use of the land and ranchers would check on cattle and maintain range projects during a few weeks during the grazing season. Rock hunters would search for petrified wood, and



Source: BLM

Map 3.21. Land Status/Prior Rights Cumulative Impact Assessment Area Boundary, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



Source: BLM

Map 3.22. Grazing Allotments, Jonah Infill Drilling Project Area and Cumulative Impact Assessment Area, Sublette and Sweetwater Counties, Wyoming, 2006.

Table 3.55. Livestock/Grazing Allotments in the Jonah Infill Drilling Project Area and Cumulative Impact Assessment Area, Sublette County, Wyoming, 2006

Grazing Allotment	Allotment Size (acres)	Federal Acres in Allotment	Total AUMs	Acres of Allotment in JIDPA	AUMs in JIDPA	Existing Disturbance in Entire Allotment (acres)	Average Federal Acres/AUM
Stud Horse Common	15,590	14,309	1,730	5,490	670	782	8.2
Sand Draw	31,740	30,445	2,324	20,740	1,571	1,147	13.2
Boundary	31,994	29,982	2,996	3,630	363	461	10.0
Blue Rim Desert	41,273	39,467	2,826	n/a [1]	--	359	14.6
No Allotment (Private)	640			640	--	28	--
Total[1]	120,597	114,203	9,876	30,500	2,604	2,777	11.5[2]

[1] n/a = 12 miles of the Burma Road upgrade area is in the Blue Rim Desert Common Allotment.
[2] Total does not include the "No Allotment"; average federal acres/AUM are not additive.

hunters would seek antelope and sage-grouse in the fall. Since development of the gas field began the area has been dominated by human activity, consisting of vehicular traffic on upgraded roads and noise from heavy equipment and drilling rigs. Where transportation was once accomplished over a few primitive two-track roads, there is now a dense network of developed roads. Forage species immediately adjacent to high traffic areas accumulate a layer of dust, which temporarily decreases palatability.

This new level of activity has caused cattle to shift their traditional use patterns. The quality of the forage on the reclaimed well pads and ROWs is attractive to livestock and antelope, as they are younger, more succulent, and easily obtained. New water sources are now available that either supplement existing livestock water sources, or provide new water in previously dry areas. Cattle mortalities have occurred from cattle drinking from drilling fluids pits, and from vehicular collisions along the upgraded roads.

To ensure successful reclamation as well as to protect other interests, fencing has been implemented around many locations. In addition to speeding the vegetation recovery of disturbed sites, this fencing has also had the effect of creating shifts in cattle use patterns and movement.

Forage demands by livestock are currently being met as permitted on the allotments within the JIDPA. This is in the wake of substantial industrial development in the affected area since 1997, where the construction of gas wells, pipelines, roads, and other related facilities have disturbed approximately 3,350 acres. As of the date of this analysis no specific studies have been conducted to evaluate the success of reclamation; however, observations reveal that today’s forage base in the JIDPA is in part supplied from the numerous acres that have been reclaimed since development began in this area.

Monitoring protocols for the reclaimed areas are being developed to determine how cattle grazing is affecting reclamation.

Blue Rim Desert Common Allotment

The Burma Road is important for access into the east side of the Blue Rim Desert grazing allotment. Grazing permittees regularly use this road to maintain range management facilities and to check on cattle. The period for this activity is from mid-April until June 20.

Stud Horse Common Allotment

This allotment is important to the permittees for spring grazing. The grazing season begins May 1 and ends June 30. This allotment contains approximately 15,590 total acres, and has two grazing permits totaling 1,729 active federal AUMs. The land area and permit relationship indicates an approximate stocking rate of 9 acres/AUM. The last actual Range Survey used for present AUM allocation occurred in 1962–63, and without a current survey it is not possible to know what the exact stocking rate is. However, periodic forage utilization monitoring indicates that there is an adequate supply of forage. The highest recorded forage utilization was 47% in grazing season 2000, and utilization levels for the past 5 years have averaged around 25–30%, which is normal for the region.

Observations during grazing seasons 2004 and 2005 have revealed that cattle grazing was concentrated on previously reclaimed areas. These areas provide readily available early forage and appear to be preferred over the native rangeland types. On open range cattle will graze the most available plants first, and within the JIDPA these occur on the reclaimed areas. When the majority of this reclamation forage is used, the grazing emphasis begins to shift to adjacent native rangeland where the forage is more available. By this time the grazing season is nearing the end and forage use on the native sites has been observed as light (10%). There has been no information to date suggesting that the use of reclamation sites by cattle or antelope is preventing the achievement of reclamation objectives.

A 1999 review of the Standards for Healthy Rangelands revealed that there was an inadequate amount of perennial bunchgrasses on the allotment's range sites, especially within 1 mile of water sources. This determination was based on general observations. For this reason the allotment did not meet the Standards, and in 2000 a reduction of 444 AUMs was implemented. However, considering the current amount of industrial development occurring in this area, it is doubtful that the results of this evaluation are relevant.

The permittees of the Stud Horse Common Allotment have entered into a joint cooperative rangeland monitoring program funded through the Secretary of the Interior's "4Cs" initiative, and through an agreement between the BLM and the Public Lands Council. Under this program, the grazing permittees jointly monitor rangeland use and health with BLM range specialists using scientifically approved rangeland monitoring methods. The monitoring primarily focuses on annual forage utilization and the long-term trend of species composition.

Sand Draw Common Allotment

This allotment is important to the permittees for spring grazing. The grazing season begins May 1 and ends June 30. This allotment contains approximately 31,740 total acres, and has two grazing permits totaling 2,324 active federal AUMs. The land area and permit relationship indicates an approximate stocking rate of 13 acres/AUM. The last actual Range Survey used for present AUM allocation occurred in 1962–63, and without a current survey it is not possible to know what the exact stocking rate is. However, periodic forage utilization monitoring indicates that there is an adequate supply of forage. The highest recorded forage utilization was 54% in grazing season 2001, and utilization levels for the past 5 years have averaged around 25–30%, which is normal for the region.

Observations during grazing seasons 2004 and 2005 have revealed that cattle grazing was concentrated on previously reclaimed areas. These areas provide readily available early forage and appear to be preferred over the native rangeland types. On open range cattle will graze the most available plants first, and within the JIDPA these occur on the reclaimed areas. When the majority of this reclamation forage is used, the grazing emphasis begins to shift to adjacent native rangeland where the forage is more available. By this time the grazing season is nearing the end and forage use on the native sites has been observed as light (10%).

A 2001 review of the Standards for Healthy Rangelands revealed that the Standards were met. This determination was based on general observations. However, considering the current amount of industrial development occurring in this area, it is doubtful that the results of this evaluation are relevant.

The permittees of the Sand Draw Common Allotment have entered into a joint cooperative rangeland monitoring program funded through the Secretary of the Interior's 4Cs initiative, and through an agreement between the BLM and the Public Lands Council. Under this program, the grazing permittees jointly monitor rangeland use and health with BLM range specialists using scientifically approved rangeland monitoring methods. The monitoring primarily focuses on annual forage utilization and the long-term trend of species composition.

Boundary Allotment

The season of use in this allotment is from May 1 until December 1. Both cattle and sheep are permitted for the allotment. There are 31,988 total acres and 2,996 active federal AUMs. The land area and permit relationship indicates an approximate stocking rate of 11 acres/AUM, and this is an approximation of the stocking rate. About 10% of the allotment occurs within the JIDPA. The allotment is managed for three-pasture deferred rotation/short duration, low-intensity grazing.

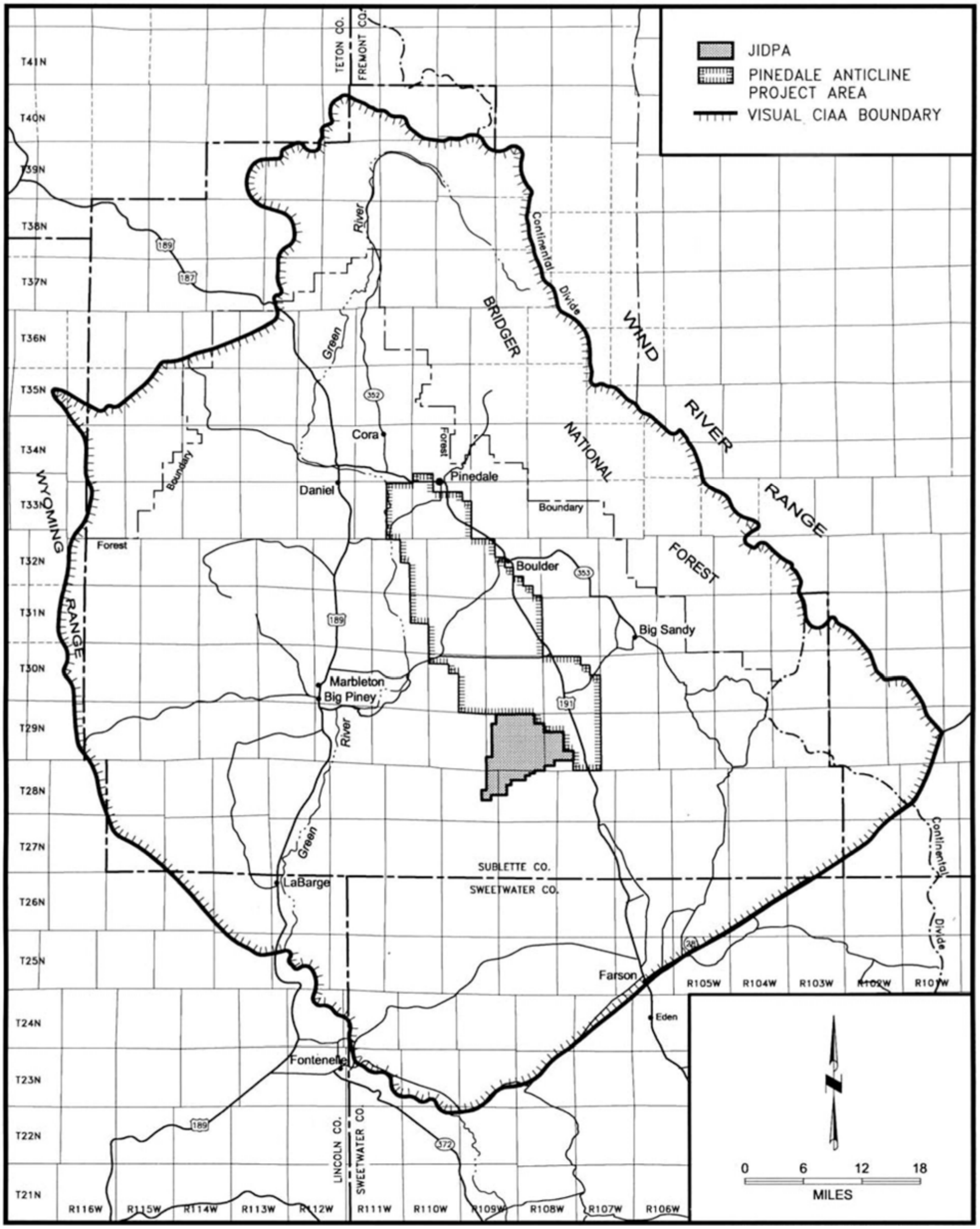
General observations show that light forage utilization is made in the northern portion of this allotment.

A 2002 review of the Standards for Healthy Rangelands revealed that the Standards were met.

The CIAA for livestock grazing is the four affected grazing allotments that encompass approximately 120,597 acres, of which the 114,203 acres of federal land provide a total of 9,876 permitted AUMs (see Table 3.55 and Map 3.22). Based upon WyGISC (2002, 2003b) digital data and aerial photographs, approximately 2.3% of the CIAA for livestock grazing (2,777 acres) has been disturbed by well pads, pipelines, resource roads, agricultural lands (i.e., hay meadows), and highways. The Sand Draw grazing allotment has the largest amount of existing disturbance with 1,147 acres (3.6% of the allotment) disturbed primarily from existing gas development in the Jonah Natural Gas Field.

3.5.3 Recreation

The CIAA for recreation encompasses 2,089,363 acres (3,264 square miles) (Map 3.23). Existing surface disturbance includes approximately 138,740 acres (216 square miles) or 6.6% of the CIAA, which is primarily a result of agriculture (83%), road and pipeline ROWs (12%), and existing natural gas development in the Jonah, Pinedale Anticline, Fontenelle, Moxa, Stagecoach Draw, LaBarge Platform, Riley Ridge, and Mesa Verde project areas (5%), as well as the Tip-Top and Hogsback Units.



Source: BLM

Map 3.23. Recreational Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Sublette and Sweetwater Counties, Wyoming, 2006.

Detailed information on recreation and recreation revenues is provided in Section 3.4.10. The following is additional information on recreation types and the importance of the various recreation types in the area.

Dean Runyan Associates, Inc. (2005) estimates that total traveler expenditures in southwestern Wyoming (Carbon, Lincoln, Sublette, Sweetwater, and Uinta Counties) were $370 million in 2004, with Sweetwater County having the most ($126.5 million) and Sublette County the least ($36 million). Vacationers represented 64% of total traveler expenditures in the five-county region. Travel spending has increased steadily since 1997 at a rate of 4.9% per year, or 2.2% per year in constant dollars (adjusted for inflation) (Dean Runyan 2005). Southwestern Wyoming is an important recreation area for Wyoming residents (University of Wyoming, Agricultural Economics Department 1997). Expenditures by out-of-state visitors for fishing, hunting, backpacking, winter sports, etc., are vital to local economies.

The *1990 Wyoming State Comprehensive Outdoor Recreation Plan* (Wyoming Department of Commerce, Division of State Parks and Historic Sites 1990), while out of date, reported that southwestern Wyoming, with 20% of the state's population, supported more than 50% of all Wyoming resident off-highway vehicle (OHV) and four-wheel drive use, 49% of all resident antelope hunting, 15% of all resident sightseeing, and 17% of all historical site visits and day hiking. Relative to its population (1.1% of state), Sublette County was especially important in terms of OHV use (21.6%), antelope hunting (15.6%), backpacking (especially designated wilderness) (18.7%), and camping (11.9%). Area-specific data were not collected for the *2003 Wyoming State Comprehensive Outdoor Recreation Plan*. While recognizing the limitations of these data, the 1990 figures are included here for reference. It is likely that certain activities (e.g., OHV use) have increased dramatically in recent years in this area.

Statewide, the most popular recreational activities include: wildlife viewing (71%); driving for pleasure (66%); hiking or walking (64%); viewing natural features such as scenery and flowers (64%); and general/other, such as relaxing, escaping crowds and noise (64%), fishing (63%), visiting historic and/or prehistoric sites (54%), and attending fairs or festivals (50%) (Wyoming Department of Commerce, Division of State Parks and Historic Sites 2003).

There are no developed recreation areas within the JIDPA; however, BLM-administered lands provide a variety of recreational opportunities, including hunting for antelope, greater sage-grouse, and small game. Hunting for big game within the JIDPA has likely seen a large decrease since the initiation of field development (Hudson pers. comm.). Backpacking, camping, cross-country skiing, snowshoeing, snowmobiling, rock collecting, sightseeing, wildlife viewing, and general photography are a few of the nonconsumptive recreational opportunities available in the region, although many of these activities likely no longer occur on the JIDPA due to existing oil and gas development. Most of these activities, other than camping associated with hunting, likely never occurred in great numbers. In recent years, commercial and private interest has increased in activities associated with wildlife watching for antelope, sage-grouse at leks, and raptors in the Pinedale Resource Management Area (Hudson pers. comm.). However, these activities are unlikely to occur in the JIPDA due to existing oil and gas development.

The Recreation Opportunity Spectrum (ROS) classification (see BLM Manual 8320, Appendix 1) for the JIDPA under the PFO RMP was semi-primitive motorized. This is expected to be changed to rural or urban under the PFO RMP revisions. The change in classification is the result of development already approved under previous NEPA documents (BLM 1998b, 2000b).

Total annual recreational visitor days (other than hunting) in the PFO from October 1, 1998, to September 30, 2002, was 319,978 (BLM 2003c). The most popular activities included boating (43%), fishing (23%), camping (11%), and hiking/walking/running (10%). Recreational use data specific to the JIDPA are not available. However, dispersed recreation related to sightseeing and OHV use does likely occur on the JIDPA because the area is designated as suitable for OHV use in the PFO RMP, and recreational hunting is likely the most important recreational activity on the JIDPA. Because the JIDPA may have importance for recreational hunting by some individuals for the game species that occur in the area (e.g., pronghorn, cottontail rabbit, and greater sage-grouse), a conservative economic analysis of recreational hunting in the JIDPA is provided in Section 3.4.10.2.

The Lake Mountain Wilderness Study Area (13,865 acres west of LaBarge) is encompassed by the CIAA for recreation. In addition, the BLM Scab Creek Wilderness Study Area (7,636 acres south of Boulder Lake) and the Bridger Wilderness Area are approximately 20 miles northeast of the area. The Scab Creek, Bridger, Fitzpatrick, and Popo Agie Wilderness provide regional opportunities for remote recreational activities.

3.5.4 Transportation

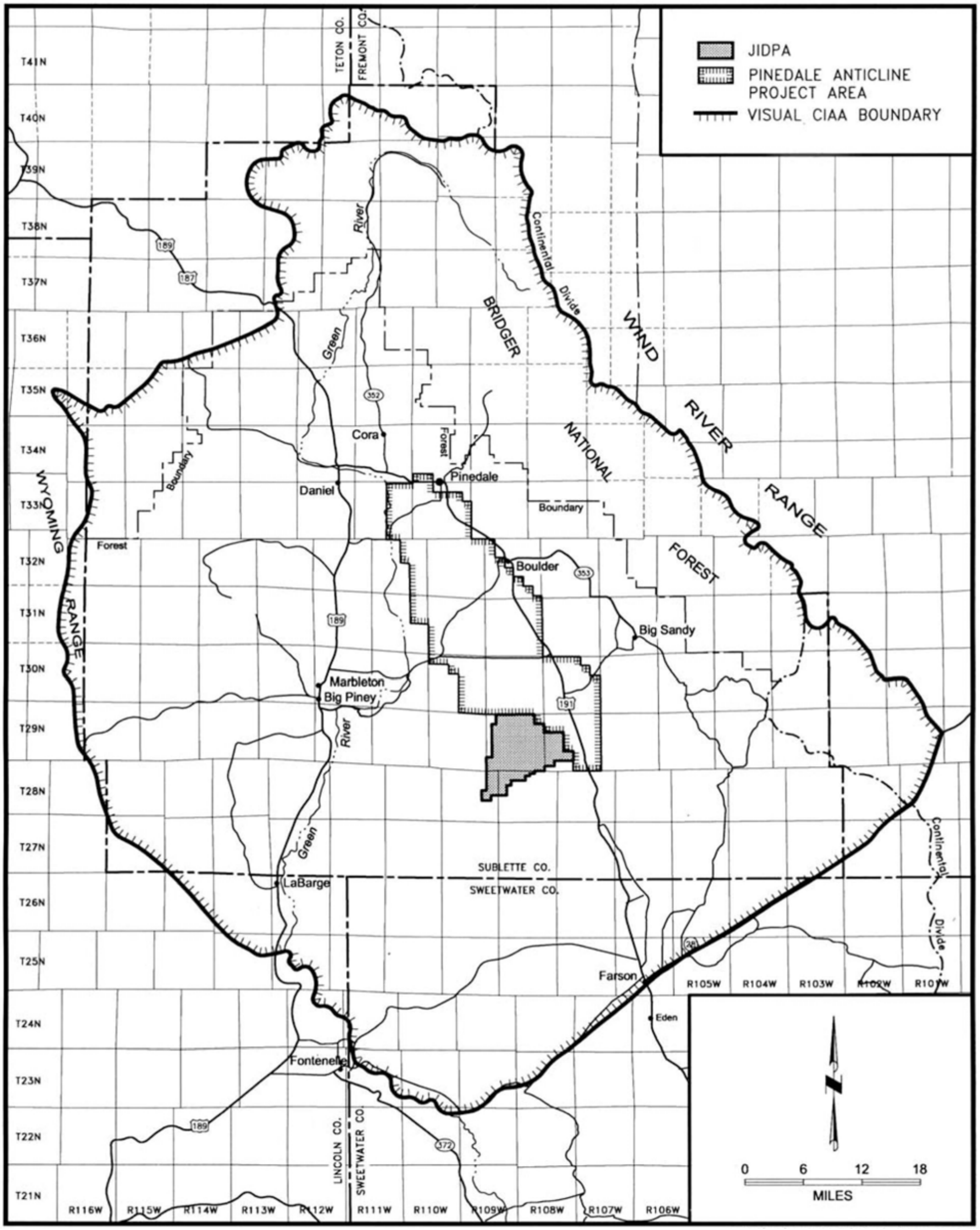
Surface transportation in the JIDPA is provided by an extensive network of collector and resource roads (see Map 2.1 and Appendix B, Subappendix DP-A). The two principal roadways to the JIDPA are State Highway 191, which links the field to Rock Springs and Pinedale, Wyoming, and State Highway 351, which links the field to Big Piney and Marbleton, Wyoming.

The main access to the JIDPA is from the Luman Road, which runs east from the JIDPA to State Highway 191. The Jonah North Road, which runs north from the JIDPA to connect with State Highway 351, also provides access to the field (see Map 2.1). Further detail on the roads in the JIDPA and associated traffic is discussed in the Transportation Plan (Appendix B, Subappendix DP-A).

3.6 VISUAL RESOURCES

The CIAA for visual resources encompasses 2,089,363 acres (3,264 square miles) (Map 3.24). Existing surface disturbance includes approximately 138,740 acres (216 square miles) or 6.6% of the CIAA and results primarily from agriculture (83%), road and pipeline ROWs (12%), and existing natural gas development in the Jonah, Pinedale Anticline, Fontenelle, Moxa, Stagecoach Draw, LaBarge Platform, Riley Ridge, and Mesa Verde project areas (5%), as well as the Tip-Top and Hogsback Units.

The Visual Resource Management (VRM) System is the basic tool used by the BLM to inventory and manage visual resources on public lands. The VRM classification combines evaluation of visual quality, visual sensitivity of the area, and view distances. The BLM's PFO was first visually inventoried and classified in 1978. VRM classes are used to identify the degree of acceptable visual change within a characteristic landscape. Classes are based on the physical and sociological characteristics of a given homogeneous area and serve as a management objective. Projects of all types within established VRM class areas will generally be required to conform with objectives and characteristics of the classification, or the project will be modified to meet the VRM class objective. Short-term modifications in portions of visual class areas may be approved if a site-specific environmental analysis determines that impacts would be acceptable.



Source: BLM

Map 3.24. Visual Cumulative Impact Assessment Area, Jonah Infill Drilling Project, Lincoln, Sublette, and Sweetwater Counties, Wyoming, 2006.

The entire JIDPA is in a Class IV VRM area. A basic description of the landscape (high desert shrub area with flat to rolling topography containing buttes and ridges) is provided in Sections 3.1.3 (Topography) and 3.2.1 (Vegetation). The landscape today is dominated by oil and gas development features (e.g., roads, well pads). The Class IV designation provides for management activities that may generate major modifications to the existing character of the landscape. Contrasts may attract attention and be a dominant feature of the landscape in terms of scale; however, the change should repeat the basic elements (form, line, color, and texture) inherent in the characteristic landscape. A Class IV VRM designation allows for modification of the landscape to accommodate natural gas production, but also advocates that surface facilities blend with surroundings to lessen the visual impacts.

The connected actions, including the proposed upgrade of the Burma Road and the modification of the project area boundary to include the north half of Section 23, T28N, R109W, are also in areas designated as VRM Class IV.

A VRM Class III area occurs as a 1-mile corridor surrounding U.S. Highway 191 just east of the JIDPA. A Class III designation provides for moderate changes to the existing landscape, although management activities associated with these changes should not dominate the view of the casual observer. For the most part, the JIDPA is not visible from U.S. Highway 191, a major corridor for tourists. However, current JIDPA developments (e.g., rig structures and production facilities) at higher elevations on Yellow Point Ridge in the southern JIDPA are visible at a distance of about 8 miles from an approximately 8- to 10-mile length of U.S. Highway 191. Additional existing oil and gas development effects visible from the highway include nighttime lights, occasional smoke plumes, and haze events. The only currently identified project feature present in the VRM Class III corridor along U.S. Highway 191 is the existing Luman Road.

3.7 HAZARDOUS MATERIALS

Hazardous materials present in the JIDPA include those used and produced in association with natural gas drilling, completion, and production, and these substances and their current management protocol are discussed in detail in the Hazardous Materials Management Summary (Appendix B, Subappendix DP-C).

3.8 COMPENSATORY MITIGATION

No compensatory (off-site) mitigation (CM) projects have been completed or are in progress.

CHAPTER 4 — ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

The potential positive and adverse impacts of construction, drilling, completion, operation, maintenance, and reclamation of the proposed project are disclosed for each affected resource under each alternative. An environmental consequence or impact is defined as a modification to the existing environment brought about by development activities. Impacts can be beneficial or adverse, can be a primary result of an action (direct impacts) or a secondary result (indirect impacts), and can be permanent or long-lasting (long-term impacts—more than 5 years) or temporary and short duration (short-term—5 years or less). Impacts can vary in degree from a slightly discernable change to a dramatic change in the environment.

Impacts are quantified whenever possible. Potential significant impacts are identified. "Significance," as defined in CEQ guidelines (40 CFR 1508.27), considers both the degree of intensity and the context of the project. Significant impacts would be the most substantial and therefore should receive the greatest attention in decision-making. The use of adjectives (e.g., "moderate," "low," "negligible") has been avoided because this EIS is an analytical document. The magnitude of an impact (i.e., its significance) is based on RMP and state and local land use planning objectives, regulatory standards, scientific and environmental documentation, and professional judgment. Impacts are considered adverse unless identified as beneficial.

Significance criteria were developed to measure the intensity of an impact, either beneficial or negative, within the context of the human environment. Developing significance criteria is difficult for a number of reasons. First, although used extensively throughout the Act, NEPA does not identify what is meant by significant on a resource-by-resource basis. Second, it is often difficult to quantify impacts for some resources. In these cases, significance criteria must be subjective and often rely on the professional opinion of the persons preparing and reviewing the impact analysis. Finally, for readers, the significance of an impact is often framed in terms of personal experience (i.e., how they perceive impact intensity within their own context). For instance, persons who benefit directly from the positive economic impacts of the project are likely to consider that impact significant. Conversely, someone who recreates in the JIDPA is likely to find the negative environmental impacts of project-related activities significant. Although this document does not predict "worst-case" impacts, it may overestimate impacts from the project. For purposes of this analysis, it is assumed that development would occur throughout the JIDPA. Overestimation is unavoidable for complete disclosure of potential or reasonable foreseeable impacts from the project.

Each resource discussed in this chapter includes a description of the following:

- Impact Significance Criteria. Current resource management goals/objectives are summarized from BLM RMP RODs (BLM 1988b, 1997b), the State of Wyoming land use plan (Wyoming State Land Use Commission [WSLUC] 1979) and the Sublette County comprehensive plan (SCBC and SCPC 2003). In general, the ability of management agencies to achieve or maintain these goals/objectives determines significance (i.e., if plan goals/objectives can no longer be met on the JIDPA or for the planning area, then the potential for a significant impact exists). For some resources, additional impact significance criteria are provided (e.g., for air resources, various legally mandated thresholds/limits are identified).

- Impacts. The level and duration of impacts anticipated to occur as a result of the No Action Alternative, the Proposed Action, Alternatives A and B, and the Preferred Alternative are described. It is assumed that BLM-identified and Operator-committed practices would be implemented to avoid or minimize adverse impacts (see Chapter 2, and Appendices A and C).
- Cumulative Impacts. These are impacts that result from the incremental impacts of an action added to other past, present, and reasonably foreseeable actions, regardless of who is responsible for such actions. Cumulative Impact Assessment Areas (CIAAs) for each resource are identified in Table 3.2 and existing disturbance/conditions in these areas are discussed in Chapter 3. Cumulative impact assessment includes past, present, and reasonably foreseeable development (RFD). RFD for this project includes development that has been analyzed and approved under NEPA, including past development in Jonah Field, existing and approved developments in the Pinedale Anticline, and others, as appropriate, as well as other likely surface disturbance (e.g., South Piney Project).
- Unavoidable Adverse Impacts. These are impacts that cannot be completely mitigated.

Mitigation and other environmental protection measures are identified across alternatives in Chapter 2. Detailed descriptions of these measures are provided in Appendix A (BLM Standards), and Appendix C (Operator-committed practices). It is assumed that the application of identified mitigation and protection measures would reduce impact levels; however, the efficacy of many mitigations is unknown. Therefore, no quantitative variation in impact levels based upon the application of variable mitigations is provided, except for air quality.

Alternative-specific mitigation and monitoring measures for the Preferred Alternative are identified in Section 2.4.5. It is assumed that these measures would impart some level of impact reduction to various resources.

Irreversible and irretrievable commitment of resources and short-term use of the environment versus long-term productivity are discussed in separate sections following the discussions of specific resources (Sections 4.8 and 4.9, respectively).

Considerable natural gas development has already occurred within the JIDPA as approved in past NEPA documents (BLM 1998b, 2000b), and impacts from this past development would continue for approximately 63 years without any further development authorizations. Most impacts associated with this project, therefore, would involve increases in the magnitude and/or duration of impacts previously described in past NEPA documents (BLM 1997a, 2000a). Additionally, preliminary research and monitoring results indicate significant adverse impacts to many area resources have already occurred with existing development and mitigation requirements. Therefore, BLM is proposing to increase on-site mitigation efforts with a particular focus on reclamation, and recommend initiation of compensatory mitigation (CM) as appropriate and consistent with BLM policy. All CM efforts would be voluntarily developed and proposed by the Operator, and following approval and authorization by BLM, would become commitments of the Operator.

For most resources, the quicker the project is implemented, the shorter the duration of impacts; therefore, pace of development may have the greatest effect on area resources. For example, the faster the gas is recovered, the sooner the surface area can be reclaimed. This fact must, however, be weighed against the potential for faster development to lead to accelerated impacts to other resources such as air quality and water resources.

4.1 PHYSICAL RESOURCES

4.1.1 Climate

An assessment of project impacts to climate is beyond the scope of this analysis and, therefore, is not discussed further in this EIS.

4.1.2 Air Quality

Direct, indirect, and cumulative air quality analyses were performed to predict maximum near-field (surrounding the JIDPA) and far-field (sensitive Class I and Class II areas) ambient air pollutant concentrations, as well as maximum impacts to visibility (regional haze) and atmospheric deposition, including "acid rain." Analyses were also performed to predict maximum mid-field (regional communities of Big Piney, Big Sandy, Boulder, Daniel, Farson, LaBarge, Merna, and Pinedale; see Map 3-1) visibility impacts and maximum in-field (within the JIDPA) concentrations.

Air pollution impacts are limited by state and federal regulations, standards, and implementation plans established under the Clean Air Act and administered by the applicable air quality regulatory agency, specifically, the WDEQ/AQD and the EPA. The States of Utah, Colorado, and Idaho have similar jurisdiction over potential air pollutant emissions sources in those states, which can have a cumulative impact when combined with WDEQ/AQD-regulated sources. The applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees, and control devices prior to construction and/or operation. The U.S. Congress (through the Clean Air Act Section 116) also authorizes local, state, and tribal air quality regulatory agencies to establish air pollution control requirements of equal or greater stringency than federal requirements. Any proposed emissions source is required to undergo a permit review by applicable air quality regulatory agencies (including state, tribal, and/or EPA) before construction can begin. The agencies review the specific air pollutant emission sources proposed and, depending upon the magnitude of emissions and other factors, the air quality regulatory agencies may require additional site-specific air quality analysis and/or additional emission control measures (including a Best Available Control Technology [BACT] analysis and determination) to ensure protection of air quality.

Although WDEQ has the regulatory authority for air quality in Wyoming, BLM also has responsibility in regard to air quality. For example, under FLPMA and the Clean Air Act, BLM cannot authorize any activity that does not conform to all applicable local, state, tribal, and federal air quality laws, statutes, regulations, standards, and implementation plans. An extensive air quality impact assessment technical support document was prepared to analyze potential impacts from the development alternatives, as well as other reasonably foreseeable emission sources. The *Jonah Infill Natural Gas Project Air Quality Technical Support Document* (TRC Environmental Corporation [TRC EC] 2006) provides additional detail on this air quality evaluation and is available for review at the PFO.

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) prescribe the following management goals/objectives associated with air quality:

- to maintain and, where possible, enhance air quality levels;
- to protect public health and safety and sensitive natural resources;

- to within authority minimize emissions which may add to acid rain, cause violations of air quality standards, or reduce visibility;
- to ensure that industries adhere to federal and state air quality standards; and
- to consider the frequency of atmospheric inversions, meteorology, topography, present ambient air quality, significant deterioration limits, and applicable local, state, and federal laws when evaluating land use proposals and development issues.

The significance criteria for potential air quality impacts include state and federally enforced legal requirements to ensure that air pollutant concentrations will remain within specific allowable levels, as well as adherence to the aforementioned RMP and land use plan goals and objectives. Legal requirements include the NAAQS and WAAQS, which set maximum limits for several air pollutants, and PSD increments, which limit the incremental increase of certain air pollutants (including NO_2, PM_{10}, and SO_2) above legally defined baseline concentration levels. These standards and increments have been presented in Table 3.7.

Where legal limits have not been established, the BLM uses best available scientific information to identify thresholds of significant adverse impacts. Thresholds or levels of concern have been identified for Hazardous Air Pollution (HAP) exposure, incremental cancer risks, a "just noticeable change" in potential visibility impacts, and potential atmospheric deposition impacts. These thresholds or levels of concern are described later in this chapter.

Air quality impacts from the project would occur from pollutants emitted during construction (due to potential surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well completion and testing, and drilling rig and vehicle engine exhaust) and production (natural gas well-site production equipment, reciprocating pipeline compression engine exhausts, vehicle traffic engine exhausts, and fugitive dust). Pollutants emitted from these activities include PM_{10}, $PM_{2.5}$, NO_X, CO, SO_2, VOC, and HAPs. O_3 may develop from NO_x and VOC emissions. Some amount of unquantified HAPs may also occur from water treatment. The amount of air pollutant emissions during construction and production will be controlled or otherwise limited in accordance with mitigations, goals, and performance objectives set forth in Sections 2.4.5 and 5.1, and Appendices A and C. Actual air quality impacts would depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions (e.g., wind speed and direction, precipitation, relative humidity).

This air quality impact assessment is based on the operations and engineering data and assumptions available at the time of the analysis, the best available meteorology data, and currently accepted dispersion modeling procedures, as well as professional and scientific judgment. Assumptions representing most likely operating conditions were incorporated into the analysis whenever possible. For example, analyzed compression was assumed to operate at 90% of permitted capacity, and drilling engines were assumed to operate at an average of 42% of maximum capacity. Parameters for which most likely field operating projections were not provided by Operators were assumed to occur at maximum proposed levels. For example, impact assessments assume that all proposed wells would be productive (no dry holes), well completion flaring activities would be required for 20% of the completed wells, and flaring would occur daily throughout the year.

The assessment of direct project impacts includes a near-field analysis and a far-field analysis, which were completed separately for project alternatives. The near-field analyses include impact assessments for comparison to applicable ambient air quality standards and for comparison to

PSD increments. All NEPA PSD demonstrations serve information purposes only and do not constitute a regulatory PSD increment consumption analysis, which may be completed as necessary by the WDEQ-AQD; preliminary results from a WDEQ PSD increment consumption analysis may be reviewed at http://deq.state.wy.us/aqd. The near-field analyses also include assessments of HAP impacts for comparison to applicable health-based levels for non-cancer compounds and cancer risk for carcinogens. The near-field analysis assesses direct impacts in the immediate vicinity of project activities resulting from a single phase of construction or production reflective of maximum emissions.

The in-field analyses are additional near-field impact assessments of field-wide source emissions for comparison to applicable ambient air quality standards and for comparison to PSD increments. The mid-field analyses assess potential changes to regional haze within Wyoming regional community locations, however these areas are classified as PSD Class II areas where no visibility protection exits under local, state, or federal law. The far-field analyses include impact assessments for comparison to applicable ambient air quality standards and for comparison to PSD increments. The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD increment consumption analysis. In addition, the far-field analyses assess potential change to regional haze and acid deposition at sensitive Class I and Class II areas, and potential increase in acidification of acid sensitive lakes within the sensitive Class I and Class II areas. The far-field analysis also assesses regional emission sources located within the model domain illustrated in Map 3.1 to predict cumulative impacts at in-field, mid-field, and far-field locations.

A summary of direct project potential near-field and far-field impacts across alternatives is provided in Table 4.1. Table 4.2 provides a detailed summary of potential direct project and cumulative impacts for each alternative compared with applicable ambient air quality standards, PSD increments, and levels of concern (LOC). Table 4.3 provides a summary of potential direct project and cumulative acid deposition impacts for each alternative compared with deposition analysis thresholds (DAT) and LOC, and lake acidity levels of acceptable change (LAC). Table 4.4 provides a summary of potential direct project and cumulative visibility impacts for each alternative.

Near-field Analysis

The near-field analysis utilized air pollutant emission rates calculated for all phases of construction and production based on WDEQ/AQD guidance in place at the time of the analysis. The EPA proposed guideline dispersion model, AERMOD was used to assess near-field impacts of PM_{10}, $PM_{2.5}$, CO, NO_2, and SO_2, and to estimate short-term and long-term HAP impacts. Impacts were assessed from the phase of single-well pad construction or field production that produced the highest emissions. The near-field analysis for PM_{10}, $PM_{2.5}$, and SO_2 focused on localized impacts from construction and drilling activity at a single well pad and analyzed direct project impacts within the JIDPA using three different well pad configurations to predict maximum impacts that could result from a single pad. A 3.8-acre single-well pad configuration, a 7-acre (two wells per pad) configuration, and a 10.0-acre (10 wells per pad) configuration were analyzed. These three scenarios reflect a range of wells per pad that may be developed under the alternatives. Direct project NO_X, CO, and HAP impacts were modeled for 3,100-well developments to reflect the maximum number of wells in production under any alternatives. NO_2 and CO impact analyses included project emissions combined with existing JIDPA wells and non-project existing and proposed compression to better approximate a NAAQS analysis under WDEQ/AQD requirements. Detailed information regarding the modeling methodologies used in the near-field analysis is provided in TRC EC (2006).

O_3 is formed through a chemical reaction between NO_x, VOCs, and ultraviolet light (sunlight) within the atmosphere. The EPA O_3 formation screening methodology (Scheffe 1988) was used to estimate maximum ozone impacts from NO_x and VOC emissions generated from the project. A representative 128-well section with a compressor station was used for this analysis. The maximum quantity of O_3 that could be formed from this project in combination with other existing projects and potential future developments is expected to be less than NAAQS. In recognition of the importance of potential ozone concentrations resulting from the increase in natural gas development activities within and nearby the JIDPA, ozone monitoring was initiated in the Jonah Field area as well as near Daniel and Boulder. Further detail on O_3 is provided in the Air Quality Technical Support Document (TRC EC 2006).

Acute (short-term) HAP impacts were modeled by assuming a person would not persistently remain at a location closer than 100 m (328 ft) from a well pad or a compressor station due to site operations safety considerations. Long-term (chronic) health-based HAP impacts and long-term (chronic) cancer risk were modeled using the realistic estimate of long-term exposure, which assumes a person would not be closer than the nearest residence on the New Fork River, located 8 miles from a well pad or compressor site, when averaged over a lifetime. Two estimates of cancer risk were made: one that corresponds to a most-likely-exposure (MLE) over a national residency average of 9 years with some time spent away from home, and one reflective of the maximally-exposed-individual (MEI) residing at one location for a lifetime with no time spent away from home. The estimated cancer risks were calculated based on EPA (1997) unit risk factors for carcinogenic constituents.

<u>Near-field Impacts Summary</u>

The near-field modeling results for the range of project alternatives are provided in Appendix J, Tables J-1 through J-8. A discussion of these results by alternative is presented in later sections. Maximum predicted concentrations of all criteria pollutants were added to the ambient background pollutant concentrations for comparison to WAAQS and NAAQS. Predicted impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 are presented in Appendix J, Tables J-1, J-2, J-3, J-4, J-5, and J-6, respectively. These tables also present the maximum impacts expressed as a percentage of the NAAQS and WAAQS. Predicted impacts from all project alternatives are less than the applicable WAAQS and NAAQS. Table J-2 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Background NO_2 concentrations are not added to modeled concentrations for comparison to the PSD Class II increment for NO_2. Predicted NO_2 impacts from all project alternatives are less than the PSD increment, and preliminary results of a WDEQ increment consumption analysis show that the current increment consumption for NO_2 in Bridger Wilderness is 5.6% (see http://deq.state.wy.us/aqd). A comparison of the maximum modeled PM_{10} and SO_2 impacts to PSD Class II increments is not presented because these maximum impacts are associated with emissions from temporary construction activities and as such they do not consume PSD Class II increment (EPA 1990, WDEQ 1993). Production-related emissions of SO_2 and PM_{10} that would be subject to PSD regulations were not modeled for this project. These impacts however, would be required by Wyoming and federal regulations to be within the applicable PSD increment thresholds. All NEPA analysis comparisons to the PSD Class II increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

Table 4.1. Summary of Primary Additional Air Quality Impacts Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

IMPACT	NO ACTION	PROPOSED ACTION	ALTERNATIVE A	ALTERNATIVE B	PREFERRED ALTERNATIVE
AIR QUALITY					
Increased concentrations of criteria pollutants and Hazardous Air Pollutants (HAPs)	No impact above existing levels; no new developments	Potential near-field concentrations would be in compliance with applicable National Ambient Air Quality Standards (NAAQS) and Wyoming Ambient Air Quality Standards (WAAQS); potential near-field concentrations could exceed the Prevention of Significant Deterioration (PSD) 24-hour PM_{10} increment but would be below the annual PM_{10} increment and below the PSD increments for all other pollutants; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below PSD increments; potential HAP impacts would be below applicable health-based levels for non-cancer compounds and within acceptable cancer risk ranges for carcinogens.	Potential near-field concentrations would be in compliance with applicable National Ambient Air Quality Standards (NAAQS) and Wyoming Ambient Air Quality Standards (WAAQS); potential near-field concentrations could exceed the PSD 24-hour PM_{10} increment but would be below the annual PM_{10} increment and below the PSD increments for all other pollutants; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below PSD increments; potential HAP impacts would be below applicable health-based levels for non-cancer compounds and within acceptable cancer risk ranges for carcinogens.	Potential near-field concentrations would be in compliance with applicable National Ambient Air Quality Standards (NAAQS) and Wyoming Ambient Air Quality Standards (WAAQS); potential near-field concentrations could exceed the PSD 24-hour PM_{10} increment but would be below the annual PM_{10} increment and below the PSD increments for all other pollutants; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below PSD increments; potential HAP impacts would be below applicable health-based levels for non-cancer compounds and within acceptable cancer risk ranges for carcinogens.	Potential near-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential near-field concentrations would be below PSD increments; potential far-field concentrations would be in compliance with applicable NAAQS and WAAQS; potential far-field concentrations would be below PSD increments; potential HAP impacts would be below applicable health-based levels for non-cancer compounds and within acceptable cancer risk ranges for carcinogens.
Visibility (regional haze) at Class I and Sensitive Class II areas (far-field)	No impact above existing levels; no new developments	Potential project impacts would be greater than 1.0 deciview (dv) for a maximum of 10 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than 1.0 dv for a maximum of 10 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than 1.0 dv for a maximum of 4 days per year; impairment at Bridger Wilderness only	Potential project impacts would be greater than 1.0 dv for a maximum of 3 days per year; impairment at Bridger Wilderness only
Visibility (regional haze) (mid-field communities)	No impact above existing levels; no new developments	Maximum of 23 days per year >1.0 dv at Big Sandy	Maximum of 23 days per year >1.0 dv at Big Sandy	Maximum of 6 days per year >1.0 dv at Big Sandy	Maximum of 4 days per year >1.0 dv at Big Sandy
Atmospheric/terrestrial deposition	No impact above existing levels; no new developments	Potential project impacts from sulfur deposition would be less than Deposition Analysis Threshold (DAT) at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT at Bridger Wilderness, Popo Agie Wilderness, and Wind River Roadless Area, and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT at Bridger Wilderness, Popo Agie Wilderness, and Wind River Roadless Area, and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT at Bridger Wilderness, and Popo Agie Wilderness, and less than DAT at all other analyzed areas	Potential project impacts from sulfur deposition would be less than DAT at all analyzed areas; potential project impacts from nitrogen deposition would be greater than DAT at Bridger Wilderness, and Popo Agie Wilderness, and less than DAT at all other analyzed areas
Sensitive lake acid neutralization capacity (ANC)	No impact above existing levels; no new developments	Potential project impacts would be less than Level of Acceptable Change (LAC) at acid sensitive lakes	Potential project impacts would be less than LAC at acid sensitive lakes	Potential project impacts would be less than LAC at acid sensitive lakes	Potential project impacts would be less than LAC at acid sensitive lakes

Table 4.2. Summary of Air Quality Concentrations Impacts Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Air Quality Component	Criteria	Source Group & Impact Area	No Action	Maximum Production (3100 wells)	Proposed Action and Alternative A	Alternative B	Preferred Alternative
Concentrations	Air Quality Standards	Project: Near-Field	N/A	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS
		Cumulative: Near-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
		Project: Far-Field	N/A	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS CO < NAAQS&WAAQS O_3 < NAAQS/WAAQS
		Cumulative: Far-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
	PSD Class I Increments [2]	Project: Far-Field	N/A	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
		Cumulative: Far-Field	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
	PSD Class II Increments [2]	Project: Near-Field	N/A	**PM_{10} 24-hr > increment** PM_{10} Annual < increment NO_2 < increment SO_2 < increment	**PM_{10} 24-hr > increment** PM_{10} Annual < increment NO_2 < increment SO_2 < increment	**PM_{10} 24-hr > increment** PM_{10} Annual < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
		Cumulative: Near-Field	PM_{10} < increment NO_2 < increment SO_2 < increment	**PM_{10} 24-hr > increment** PM_{10} Annual < increment NO_2 < increment SO_2 < increment	**PM_{10} 24-hr > increment** PM_{10} Annual < increment NO_2 < increment SO_2 < increment	**PM_{10} 24-hr > increment** PM_{10} Annual < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
		Project: Far-Field	N/A	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
		Cumulative: Far-Field	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
	HAP Risk Assessment	Project: Near-Field	**N/A**	All < Health Based LOC	All < Health Based LOC	All < Health Based LOC	All < Health Based LOC
		Project: Far-Field	**N/A**	All < Health Based LOC	All < Health Based LOC	All < Health Based LOC	All < Health Based LOC

[1] Results shown in normal text indicate impacts are below ambient air quality standards, PSD increments, and BLM-recognized significant threshold values and levels of concern. Results shown in bold text indicate that potential impacts are above these levels.

[2] The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increment consumption analysis.

Table 4.3. Summary of Acid Deposition Impacts Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Air Quality Component	Criteria	Source Group & Impact Area	No Action	Maximum Production (3100 wells)	Alternative A	Alternative B	Preferred Alternative
Atmospheric Deposition	N Deposition	Project: Far-Field	**N/A**	**Bridger WA, N > DAT** Fitzpatrick WA, N < DAT Popo Agie WA, N < DAT Wind River RA, N < DAT Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT	**Bridger WA, N > DAT** Fitzpatrick WA, N < DAT **Popo Agie WA, N > DAT** **Wind River RA, N > DAT** Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT	**Bridger WA, N > DAT** Fitzpatrick WA, N < DAT **Popo Agie WA, N > DAT** Wind River RA, N < DAT Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT	**Bridger WA, N > DAT** Fitzpatrick WA, N < DAT **Popo Agie WA, N > DAT** Wind River RA, N < DAT Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT
		Total: Far-Field	N < LOC, All Areas	N < LOC, All Areas	N < LOC, All Areas	N < LOC, All Areas	N < LOC, All Areas
	S Deposition	Project: Far-Field	**N/A**	N < DAT, All Areas	N < DAT, All Areas	N < DAT, All Areas	N < DAT, All Areas
		Total: Far-Field	S < LOC, All Areas	S < LOC, All Areas	S < LOC, All Areas	S < LOC, All Areas	S < LOC, All Areas
	Sensitive Lakes	Project: Far-Field	N/A	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes
		Cumulative: Far-Field	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes

[1] Results shown in normal text indicate impacts are below recognized thresholds and levels. Results shown in bold text indicate that potential impacts are above these levels.

Table 4.4. Summary of Visibility (Regional Haze) Impacts Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Air Quality Component	Impact Area	Source Group	No Action	Maximum Production (3100 wells)	Alternative A	Alternative B	Preferred Alternative
Visibility (Regional Haze)	PSD Class I and Sensitive Class II Areas	Project	**N/A**	**Bridger WA, >1.0dv 1 days, max dv = 1.14** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.15 Popo Agie WA, >1.0dv 0 days, max dv = 0.24 Wind River RA, >1.0dv 0 days, max dv = 0.20 Grand Teton NP, >1.0dv 0 days, max dv = 0.08 Teton WA, >1.0dv 0 days, max dv = 0.03 Yellowstone NP, >1.0dv 0 days, max dv = 0.04 Washakie WA, >1.0dv 0 days, max dv = 0.06	**Bridger WA, >1.0dv 10 days, max dv = 3.48** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.64 Popo Agie WA, >1.0dv 0 days, max dv = 0.62 Wind River RA, >1.0dv 0 days, max dv = 0.52 Grand Teton NP, >1.0dv 0 days, max dv = 0.33 Teton WA, >1.0dv 0 days, max dv = 0.14 Yellowstone NP, >1.0dv 0 days, max dv = 0.16 Washakie WA, >1.0dv 0 days, max dv = 0.24	**Bridger WA, >1.0dv 4 days, max dv = 1.90** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.32 Popo Agie WA, >1.0dv 0 days, max dv = 0.34 Wind River RA, >1.0dv 0 days, max dv = 0.28 Grand Teton NP, >1.0dv 0 days, max dv = 0.17 Teton WA, >1.0dv 0 days, max dv = 0.07 Yellowstone NP, >1.0dv 0 days, max dv = 0.08 Washakie WA, >1.0dv 0 days, max dv = 0.12	**Bridger WA, >1.0dv 3 days, max dv = 1.66** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.33 Popo Agie WA, >1.0dv 0 days, max dv = 0.29 Wind River RA, >1.0dv 0 days, max dv = 0.26 Grand Teton NP, >1.0dv 0 days, max dv = 0.14 Teton WA, >1.0dv 0 days, max dv = 0.06 Yellowstone NP, >1.0dv 0 days, max dv = 0.06 Washakie WA, >1.0dv 0 days, max dv = 0.10
		Cumulative	**Bridger WA, >1.0dv 3 days, max dv = 1.94** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.49 Popo Agie WA, >1.0dv 0 days, max dv = 0.58 Wind River RA, >1.0dv 0 days, max dv = 0.81 Grand Teton NP, >1.0dv 0 days, max dv = 0.33 Teton WA, >1.0dv 0 days, max dv = 0.14 Yellowstone NP, >1.0dv 0 days, max dv = 0.16 Washakie WA, >1.0dv 0 days, max dv = 0.17	**Bridger WA, >1.0dv 4 days, max dv = 2.26** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.56 Popo Agie WA, >1.0dv 0 days, max dv = 0.66 Wind River RA, >1.0dv 0 days, max dv = 0.92 Grand Teton NP, >1.0dv 0 days, max dv = 0.35 Teton WA, >1.0dv 0 days, max dv = 0.16 Yellowstone NP, >1.0dv 0 days, max dv = 0.17 Washakie WA, >1.0dv 0 days, max dv = 0.20	**Bridger WA, >1.0dv 17 days, max dv = 4.01** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.87 Popo Agie WA, >1.0dv 0 days, max dv = 0.99 **Wind River RA, >1.0dv 2 days, max dv = 1.21** Grand Teton NP, >1.0dv 0 days, max dv = 0.50 Teton WA, >1.0dv 0 days, max dv = 0.24 Yellowstone NP, >1.0dv 0 days, max dv = 0.25 Washakie WA, >1.0dv 0 days, max dv = 0.34	**Bridger WA, >1.0dv 7 days, max dv = 2.71** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.61 Popo Agie WA, >1.0dv 0 days, max dv = 0.78 **Wind River RA, >1.0dv 1 days, max dv = 1.01** Grand Teton NP, >1.0dv 0 days, max dv = 0.36 Teton WA, >1.0dv 0 days, max dv = 0.18 Yellowstone NP, >1.0dv 0 days, max dv = 0.18 Washakie WA, >1.0dv 0 days, max dv = 0.25	**Bridger WA, >1.0dv 6 days, max dv = 2.62** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.57 Popo Agie WA, >1.0dv 0 days, max dv = 0.75 Wind River RA, >1.0dv 0 days, max dv = 0.96 Grand Teton NP, >1.0dv 0 days, max dv = 0.35 Teton WA, >1.0dv 0 days, max dv = 0.17 Yellowstone NP, >1.0dv 0 days, max dv = 0.18 Washakie WA, >1.0dv 0 days, max dv = 0.23
	Wyoming Regional Communities	Project	**N/A**	Big Piney, >1.0dv 0 days, max dv = 0.66 Big Sandy, >1.0dv 0 days, max dv = 0.85 Boulder, >1.0dv 0 days, max dv = 0.56 Bronx, >1.0dv 0 days, max dv = 0.36 Cora, >1.0dv 0 days, max dv = 0.69 Daniel, >1.0dv 0 days, max dv = 0.57 Farson, >1.0dv 0 days, max dv = 0.55 Labarge, >1.0dv 0 days, max dv = 0.30 Merna, >1.0dv 0 days, max dv = 0.22 **Pinedale, >1.0dv 1 days, max dv = 1.07**	**Big Piney, >1.0dv 6 days, max dv = 2.01** **Big Sandy, >1.0dv 23 days, max dv = 3.05** **Boulder, >1.0dv 12 days, max dv = 2.39** **Bronx, >1.0dv 1 days, max dv = 1.70** **Cora, >1.0dv 1 days, max dv = 3.20** **Daniel, >1.0dv 1 days, max dv = 2.56** **Farson, >1.0dv 6 days, max dv = 2.33** **Labarge, >1.0dv 2 days, max dv = 1.32** Merna, >1.0dv 0 days, max dv = 0.79 **Pinedale, >1.0dv 3 days, max dv = 4.27**	**Big Piney, >1.0dv 1 days, max dv = 1.04** **Big Sandy, >1.0dv 6 days, max dv = 1.79** **Boulder, >1.0dv 3 days, max dv = 1.24** Bronx, >1.0dv 0 days, max dv = 0.85 **Cora, >1.0dv 1 days, max dv = 1.66** **Daniel, >1.0dv 1 days, max dv = 1.32** **Farson, >1.0dv 3 days, max dv = 1.21** Labarge, >1.0dv 0 days, max dv = 0.66 Merna, >1.0dv 0 days, max dv = 0.42 **Pinedale, >1.0dv 1 days, max dv = 2.39**	Big Piney, >1.0dv 0 days, max dv = 0.92 **Big Sandy, >1.0dv 4 days, max dv = 1.45** **Boulder, >1.0dv 2 days, max dv = 1.10** Bronx, >1.0dv 0 days, max dv = 0.89 **Cora, >1.0dv 1 days, max dv = 1.75** **Daniel, >1.0dv 1 days, max dv = 1.37** **Farson, >1.0dv 1 days, max dv = 1.19** Labarge, >1.0dv 0 days, max dv = 0.57 Merna, >1.0dv 0 days, max dv = 0.35 **Pinedale, >1.0dv 1 days, max dv = 2.37**
		Cumulative	**Big Piney, >1.0dv 7 days, max dv = 2.18** **Big Sandy, >1.0dv 2 days, max dv = 1.45** **Boulder, >1.0dv 4 days, max dv = 2.92** Bronx, >1.0dv 0 days, max dv = 0.74 Cora, >1.0dv 0 days, max dv = 0.85 Daniel, >1.0dv 0 days, max dv = 0.79 **Farson, >1.0dv 3 days, max dv = 1.48** **Labarge, >1.0dv 6 days, max dv = 1.86** Merna, >1.0dv 0 days, max dv = 0.98 **Pinedale, >1.0dv 2 days, max dv = 1.78**	**Big Piney, >1.0dv 11 days, max dv = 2.26** **Big Sandy, >1.0dv 9 days, max dv = 1.88** **Boulder, >1.0dv 5 days, max dv = 3.04** Bronx, >1.0dv 0 days, max dv = 0.77 Cora, >1.0dv 0 days, max dv = 0.93 Daniel, >1.0dv 0 days, max dv = 0.89 **Farson, >1.0dv 8 days, max dv = 1.69** **Labarge, >1.0dv 6 days, max dv = 2.05** **Merna, >1.0dv 1 days, max dv = 1.01** **Pinedale, >1.0dv 5 days, max dv = 1.94**	**Big Piney, >1.0dv 20 days, max dv = 2.62** **Big Sandy, >1.0dv 34 days, max dv = 3.62** **Boulder, >1.0dv 21 days, max dv = 3.70** **Bronx, >1.0dv 1 days, max dv = 1.79** **Cora, >1.0dv 8 days, max dv = 3.32** **Daniel, >1.0dv 11 days, max dv = 2.67** **Farson, >1.0dv 12 days, max dv = 2.75** **Labarge, >1.0dv 12 days, max dv = 2.90** **Merna, >1.0dv 5 days, max dv = 1.13** **Pinedale, >1.0dv 10 days, max dv = 4.41**	**Big Piney, >1.0dv 14 days, max dv = 2.34** **Big Sandy, >1.0dv 16 days, max dv = 2.43** **Boulder, >1.0dv 9 days, max dv = 3.17** Bronx, >1.0dv 0 days, max dv = 0.94 **Cora, >1.0dv 3 days, max dv = 1.80** **Daniel, >1.0dv 2 days, max dv = 1.44** **Farson, >1.0dv 10 days, max dv = 2.04** **Labarge, >1.0dv 6 days, max dv = 2.37** **Merna, >1.0dv 1 days, max dv = 1.05** **Pinedale, >1.0dv 8 days, max dv = 2.55**	**Big Piney, >1.0dv 13 days, max dv = 2.28** **Big Sandy, >1.0dv 12 days, max dv = 2.13** **Boulder, >1.0dv 9 days, max dv = 3.09** Bronx, >1.0dv 0 days, max dv = 0.97 **Cora, >1.0dv 2 days, max dv = 1.86** **Daniel, >1.0dv 2 days, max dv = 1.47** **Farson, >1.0dv 10 days, max dv = 1.87** **Labarge, >1.0dv 6 days, max dv = 2.30** **Merna, >1.0dv 1 days, max dv = 1.03** **Pinedale, >1.0dv 6 days, max dv = 2.50**

[1] Results shown in normal text indicate impacts are below 1.0 dv. Results shown in bold text indicate that potential impacts are above 1.0 dv.

Appendix J, Tables J-7 and J-8 summarize modeled HAP impacts representative of all project alternatives. For all alternatives, the predicted acute and chronic (long-term) impacts would be below applicable health-based levels for non-cancer compounds. In addition, calculated cancer risks from formaldehyde and benzene are less than the level of acceptable cancer risk of 1×10^{-6} (one in one million) for both the MLE and MEI scenarios except for MEI benzene scenario, which falls at the lower end of the presumptively acceptable risk range of 1×10^{-4} to 1×10^{-6} as stated by EPA (EPA 1999).

When reviewing predicted near-field impacts, it is important to understand that results reported reflect the maximum pollutant emission rates calculated for the field and the resulting concentrations are combined with monitored background ambient pollutant concentrations. Maximum monitored background air pollutant concentrations were assumed to occur throughout the LOP at all locations in the region year-round. In addition, the maximum predicted air quality impacts from JIDPA emission sources would occur in the vicinity of the JIDPA. Because impacts typically lessen with distance from an emissions source, impacts at locations more distant from the JIDPA would be less than the predicted maximum concentrations. Finally, total air pollutant concentrations for comparison to WAAQS and NAAQS were assumed to be the sum of the maximum modeled concentration and the maximum background concentration. This methodology is used for both long-term and short-term averaging periods. For short-term averaging periods, these maximum concentrations may occur under very different meteorological conditions and may not occur simultaneously.

Far-field Analysis

The far-field analysis utilized the EPA CALMET/CALPUFF modeling system to predict maximum potential air quality impacts at mandatory federal PSD Class I and other sensitive PSD Class II areas, as well as designated acid-sensitive lakes within these areas, and at in-field locations within the JIDPA. The analysis also included an assessment of maximum mid-field (regional community) visibility impacts for the Wyoming regional community locations of Big Piney, Boulder, Bronx, Cora, Daniel, Farson, LaBarge, Merna, and Pinedale although these communities are classified as PSD Class II areas where no visibility protection exits under local, state, or federal law.

The air emissions modeled for project and non-project sources in the far-field analysis are presented in Appendix J, Table J-9. Modeling scenarios were developed to approximate a range of project development including the No Action Alternative, Proposed Action, Alternative A, Alternative B, and the Preferred Alternative. These modeling scenarios assumed the maximum field emissions that could potentially occur concurrently during the final year of construction (representing the maximum annual construction activity rate) combined with nearly full-field production. For comparison purposes, an analysis of the JIDPA in full production, after all construction activities have ceased, is also presented for all alternatives with 3,100 producing wells. Maximum emissions scenarios include production emissions (producing well sites and ancillary equipment) and construction emissions (drilling rigs and pit flaring operations), both occurring continuously over the year. The maximum emissions scenarios are based on an estimate of what the maximum field emissions could be on any day during the year, and these emissions are modeled for each day of the year. Therefore, annual concentration and deposition estimates are reasonable but conservative. A well development rate of 250 wells per year (WDR250) was assumed for the Proposed Action, Alternative A and Preferred Alternative. Alternative B assumed a 75 well per year development rate (WDR75). WDR250 assumes simultaneous operation of 20 drilling rigs and three pit flares, and WDR75 assumes simultaneous operation of 6 drilling rigs and one pit flare. Development rates considered both straight and directional drilling operations generally consistent with the various proposed project alternatives. The Proposed Action and Alternative A assumed all straight-hole drilling. Alternative B assumed all directional drilling, and the Preferred Alternative assumed a combination of 50% straight hole drilling and 50% directional drilling operations. Details on modeling methodology are presented in the Air Quality Technical Support Document (TRC EC 2006).

Predicted pollutant concentrations were compared to applicable ambient air quality standards and to PSD Class I and Class II increments, and were used to assess potential impacts to AQRVs—visibility (regional haze) and acid deposition—at sensitive PSD Class I and II areas. Ambient background concentrations were added to modeled concentrations for comparison to ambient air quality standards. No ambient background was added to modeled concentrations for comparison to PSD Class I and II increments. PSD Class I areas and sensitive Class II areas analyzed in the far-field analyses include the following:

- Bridger Wilderness Area (Class I),
- Fitzpatrick Wilderness Area (Class I),
- Popo Agie Wilderness Area (Class II),
- Wind River Roadless Area (Class II),
- Grand Teton National Park (Class I),
- Teton Wilderness Area (Class I) ,
- Yellowstone National Park (Class I), and
- Washakie Wilderness Area (Class I).

Because emissions sources under the Proposed Action and alternatives consist of many small sources spread out over a large area, discrete visible plumes are not likely to impact distant sensitive areas. However, visible plumes may be noticeable within the JIDPA from nearby travel routes and at nearby towns on occasion, especially during flaring upset conditions. Nonetheless, the potential for cumulative visibility impacts (increased regional haze) is a concern.

Regional haze is caused by light scattering and light absorption by fine particles and gases. Potential changes to regional haze are calculated in terms of a perceptible "just noticeable change in visibility" when compared to background conditions, expressed in deciviews (dv). The BLM considers a potential 1.0-dv change to be a significant adverse impact. Although there are no applicable local, state, tribal, or federal regulatory visibility standards, the BLM has the responsibility under the Clean Air Act to assess visibility impacts. Other federal agencies use a 0.5-dv change as a screening threshold for significance. The USFS and NPS compare direct project impacts to the 0.5-dv level, and those comparisons are included in the Air Quality Technical Support Document (TRC EC 2006).

The NPS, USFS, and USFWS have published the *Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report* (FLAG 2000) that prescribes several methods for assessing impacts of new and existing sources on AQRVs, including visibility. The FLAG Report describes a cumulative impacts analysis of new growth sources (defined as PSD increment-consuming sources) on visibility. If predicted visibility impacts are above a visibility threshold of 1.0 dv for all days, factors such as magnitude of dv change, frequency, seasonal variations, and meteorological conditions may be considered when assessing the significance of predicted impacts.

Potential changes in regional haze at PSD Class I and sensitive PSD Class II areas were estimated by comparing CALPUFF modeled impacts to background visibility conditions in Class I or sensitive Class II areas. This comparison was performed using two different representations of background visibility conditions. One method used visibility values provided in the FLAG Report for each Class I area to represent natural background visibility. The second method used estimated background visibility values from an analysis of recent long-term monitored data (1988–2002) from the IMPROVE program. This analysis consisted of estimating visibility parameters for representative Class I areas corresponding to the monitoring period of record quarterly average of the 20% best visibility days. BLM recognizes that federal agencies may use different methods to calculate visibility impairment. Further detail can be found in TRC EC (2006: Section 4.6.4 and Appendix J).

Potential changes to regional haze resulting from project source emissions were also estimated for nearby communities (mid-field) although these communities are classified as PSD Class II areas where no visibility protection exits under local, state, or federal law. Model-predicted concentration impacts within these communities were used to estimate potential impacts to visibility. Background visibility data monitored at the Class I Bridger Wilderness Area were used to estimate potential visibility impairment in these residential areas. These data were used because no visibility monitoring has been conducted in populated areas of the region. Because anthropogenic emissions (traffic, wood stoves, furnaces, etc.) exist in the residential locations it is likely that the visibility data measured in the Bridger Wilderness Area are more pristine than what would be measured in the residential areas. Therefore, because visibility impacts are calculated as percent increases of modeled concentrations above background values, the use of these data may overestimate the potential visibility impacts at these communities.

Seven lakes within the sensitive PSD Class I and Class II Wilderness Areas were identified as being sensitive to acid deposition. These lakes are those for which the most recent and complete data are available and include the following:

- Deep Lake in the Bridger Wilderness Area,
- Black Joe Lake in the Bridger Wilderness Area,
- Hobbs Lake in the Bridger Wilderness Area,
- Lazy Boy Lake in the Bridger Wilderness Area,
- Upper Frozen Lake in the Bridger Wilderness Area,
- Ross Lake in the Fitzpatrick Wilderness Area, and
- Lower Saddlebag Lake in the Popo Agie Wilderness Area.

The NPS (2001) has identified Deposition Analysis Thresholds (DATs) for total nitrogen (N) and sulfur (S) deposition in the western U.S. as 0.005 kilograms per hectare per year (kg/ha-year) for both N and S. The DAT is used as an analysis threshold for evaluating potential impacts from project-related emissions. The USFS (Fox et al. 1989) has defined thresholds below which no adverse impacts from acid deposition are likely; however, the USFS has concerns that these deposition thresholds are set too high. These thresholds (herein referred to as levels of concern), defined as 5 kg/ha-yr for S and 3 kg/ha-yr for N, are used for comparison of potential impacts from cumulative source emissions. The USFS Rocky Mountain Region has also developed a screening method (USFS 2000) that identifies a Limit of Acceptable Change (LAC) in lake chemistry. The LACs are 1) no more than a 10% change in acid-neutralizing capacity (ANC) for lakes with an existing ANC of 25 microequivalents per liter (μeq/l) or greater and 2) no more than a 1-μeq/l change for extremely acid-sensitive lakes where the existing ANC is below 25 μeq/l. Of the seven lakes identified by the USFS as acid-sensitive, Upper Frozen and Lazy Boy lakes are considered extremely acid-sensitive.

Far-field Impacts Summary

An overall summary of maximum direct project far-field impacts by alternative is provided in Tables 4.1, 4.2, and 4.3. Pollutant concentrations under all project alternatives would be below applicable ambient air quality standards and PSD increments at far-field locations (see Appendix J, Tables J-10 through J-16). Direct project NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area for various development alternatives, and would be below the SILs at all other sensitive areas. The SILs are defined under the New Source Review (NSR) program and are applicable to impacts from a single facility only. The SILs are used to determine the need for further modeling analyses, and are not an indicator of "significance" as defined within a NEPA analysis.

Direct project visibility impacts from all alternatives were predicted to be above "just noticeable visibility changes" (1.0-dv) threshold at the Bridger Wilderness Area (see Appendix J, Tables J-17 and J-18). FLAG (2000) identifies a goal that any specific project combined with cumulative new source growth will have no days of visibility impairment at or above 1.0 dv in any Class I area. There were no predicted direct project impacts above the 1.0-dv threshold at any other analyzed sensitive area.

Direct project source emissions under all project alternatives would not result in an increase in ANC above any LAC at the acid-sensitive lakes (see Appendix J, Tables J-19 through J-21). The predicted maximum deposition impacts (Appendix J, Table J-20) from the Proposed Action are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. Under the Proposed Action and Alternative B scenarios, the maximum predicted N impacts are above the 0.005 kg/ha-yr DAT at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and are below the DAT at all other sensitive areas. For Alternative B and the Preferred Alternative, the maximum predicted N impacts are above the 0.005 kg/ha-yr DAT at the Bridger and Popo Agie Wilderness Areas, and are below the DAT at all other sensitive areas.

The number of days of direct project visibility impacts within the mid-field (Wyoming regional communities) were predicted to be above the "just noticeable visibility change" (1.0-dv) threshold as shown in Appendix J, Tables J-22 and J-23.

Estimated direct project impacts at in-field locations are below the applicable ambient air quality standards (see Appendix J, Table J-24). For the Proposed Action, Alternative A, and Alternative B scenarios, potential in-field (near-field) concentrations could exceed the PSD 24-hour PM_{10} increment but are below the annual PM_{10} increment and below the PSD increments for all other pollutants. However, this PSD comparison is for information purposes only and does not constitute a regulatory PSD increment consumption analysis.

A presentation of the aforementioned results for each alternative and for cumulative source impacts is presented below.

4.1.2.1 No Action Alternative

Near-field Impacts

No project-related near-field impacts beyond currently approved levels would occur in the JIDPA under the No Action Alternative. As a result, near-field air quality impacts and air quality would remain similar to existing levels.

Far-field Impacts

No new project-related development would occur under the No Action Alternative; therefore, air quality would remain similar to existing levels.

Mid-field and In-field Impacts

No project-related mid-field and in-field impacts beyond currently approved levels would occur in the JIDPA under the No Action Alternative. As a result, mid-field and in-field air quality impacts and air quality would remain similar to existing levels.

4.1.2.2 Proposed Action

Near-field Impacts

The construction or production phase of the Proposed Action that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of the Proposed Action modeled were: PM_{10} and $PM_{2.5}$ using a 3.8-acre pad; SO_2 using straight hole drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 128 wells per section (5.0-acre surface well spacing). These configurations result in the maximum predicted impacts for the Proposed Action.

The maximum predicted impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix J, Tables J-1, J-2, J-3, J-4, J-5, and J-6, respectively. Appendix J, Table J-1 also presents a comparison of maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Proposed Action source emissions are less than the applicable WAAQS, NAAQS, and PSD increments.

Appendix J, Tables J-7 and J-8 summarize modeled HAP impacts based on emissions representative of the Proposed Action.

Far-field Impacts

Direct impacts from the Proposed Action maximum emissions scenario (the last year of field construction and the full field in production) were modeled as set forth in the *Jonah Infill Natural Gas Project Air Quality Technical Support Document* (TRC EC 2006). The emissions modeled are provided in Appendix J, Table J-1. Appendix J, Tables J-10, J-11, J-12, and J-13 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix J, Tables J-14, J-15, and J-16 present the maximum modeled Proposed Action impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from Proposed Action source emissions would be below the applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from the Proposed Action were predicted to be above the “just noticeable visibility change” (1.0-dv) threshold at the Bridger Wilderness Area, using both the FLAG and IMPROVE background visibility data. The visibility impacts resulting from direct project source emissions are provided in Appendix J, Table J-17 for the FLAG background visibility data, and in

Table J-18 for the IMPROVE background visibility data. Visibility impacts at all other sensitive areas were predicted to be below the “just noticeable visibility change” threshold for all days.

Direct project source emissions from the Proposed Action would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix J, Table J-19). The predicted maximum S deposition impacts (Appendix J, Table J-20) from the Proposed Action are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. For the maximum emissions scenario, maximum N impacts (Appendix J, Table J-21) are predicted to be above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and below the DAT at all other sensitive areas. The maximum predicted N deposition impacts from the full field in production emissions scenario are above the DAT at the Bridger Wilderness Area and below the DAT at all other sensitive areas. The exceedances of this threshold trigger a management concern but are not necessarily indicative of an adverse impact (NPS 2004).

Mid-field Impacts

Maximum visibility impacts and the estimated number of days predicted to be above the “just noticeable visibility change” (1.0-dv) threshold at nearby Wyoming communities from the Proposed Action source emissions scenarios are shown in Appendix J, Table J-22 for the FLAG visibility data and Table J-23 for the IMPROVE visibility data.

In-field Impacts

Appendix J, Table J-24 presents the maximum impacts from all Proposed Action source emissions compared to ambient air quality standards estimated to occur within the JIDPA. These project-related impacts are below applicable ambient air quality standards. Potential in-field (near-field) concentrations could exceed the PSD 24-hour PM_{10} increment but are below the annual PM_{10} increment and below the PSD increments for all other pollutants.

4.1.2.3 Alternative A

Near-field Impacts

The construction or production phase of the Alternative A scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative A modeled were: PM_{10} and $PM_{2.5}$ using a 3.8-acre pad; SO_2 using straight hole drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 128 wells per section (5.0-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative A.

The predicted impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparisons of these impacts to WAAQS and NAAQS are presented in Appendix J, Tables J-1, J-2, J-3, J-4, J-5, and J-6, respectively. Appendix J, Table J-1 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative A source emissions are less than the applicable WAAQS, NAAQS and PSD increments.

Appendix J, Tables J-8 and J-9 summarize modeled HAP impacts based on emissions from Alternative A sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ from Alternative A were estimated at each of the eight Class I and sensitive Class II areas. The emissions modeled for Alternative A scenarios are provided in Appendix J, Table J-9. Appendix J, Tables J-10, J-11, J-12, and J-13 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix J, Tables J-14, J-15, and J-16 present the maximum modeled Alternative A concentration impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from Alternative A source emissions scenarios are less than the applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed the proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative A source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each of the three development rate alternatives, using both the FLAG and IMPROVE background visibility data. The visibility impacts resulting from direct project source emissions are provided in Appendix J, Table J-17 for the FLAG background visibility data and in Table J-18 for the IMPROVE background visibility data.

Direct project source emissions from Alternative A would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix J, Table J-19). The predicted maximum S deposition impacts (Appendix J, Table J-20) from Alternative A sources are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. The predicted N impacts (Appendix J, Table J-21) are above the 0.005 kg/ha-yr threshold at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area, and below the DAT at all other sensitive areas.

Mid-field Impacts

The maximum visibility impacts (dv) and estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming towns for Alternative A scenarios are shown in Appendix J, Tables J-22 for the FLAG visibility data and J-23 for the IMPROVE visibility data.

In-field Impacts

Model predicted concentrations of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$, resulting from Alternative A source emissions at locations within the JIDPA are shown in Appendix J, Table J-24. The estimated project-related impacts are less than applicable ambient air quality standards. Potential in-field (near-field) concentrations could exceed the PSD 24-hour PM_{10} increment but are below the annual PM_{10} increment and below the PSD increments for all other pollutants.

4.1.2.4 Alternative B

Near-field Impacts

The construction or production phase of Alternative B scenarios that would produce maximum emissions were identified by pollutant and analyzed. The maximum emissions configurations representative of Alternative B modeled were: PM_{10} and $PM_{2.5}$ using a 10.0-acre pad; SO_2 using directional drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 16 well pads per section (40-acre surface well spacing). These configurations result in the maximum predicted impacts for Alternative B.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and comparison of these impacts to WAAQS and NAAQS are presented in Appendix J, Tables J-1, J-2, J-3, J-4, J-5, and J-6, respectively. Appendix J, Table J-1 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from Alternative B source emissions are less than applicable WAAQS, NAAQS and PSD increments.

Appendix J, Tables J-7 and J-8 summarize modeled HAP impacts based on emissions from Alternative B sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ were estimated at each of the eight Class I and sensitive Class II areas. The emissions modeled for Alternative B scenarios are provided in Appendix J, Table J-9. Appendix J, Tables J-10, J-11, J-12, and J-13 present the maximum predicted concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix J, Tables J-14, J-15, and J-16 present the maximum modeled Alternative B impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from all Alternative B source emissions scenarios would be below applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from Alternative B source emissions are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. A summary of these impacts is provided in Appendix J, Tables J-17 (FLAG) and J-18 (IMPROVE). Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions from Alternative B would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix J, Table J-19). Predicted maximum S deposition impacts (Appendix J, Table J-20) from Alternative B sources are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. The predicted N impacts (Appendix J, Table J-21) are above the DAT at the Bridger Wilderness and Popo Agie Wilderness and below the DAT at all other sensitive areas.

Mid-field Impacts

The maximum visibility impacts (dv) and estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming towns from Alternative B scenarios are shown in Appendix J, Tables J-22 (FLAG) and J-23 (IMPROVE).

In-field Impacts

Model predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Alternative B source emissions at locations within the JIDPA are shown in Appendix J, Table J-24. The estimated project-related impacts are below applicable ambient air quality standards.

Potential in-field (near-field) concentrations could exceed the PSD 24-hour PM_{10} increment but are below the annual PM_{10} increment and below the PSD increments for all other pollutants.

4.1.2.5 BLM Preferred Alternative

Various configurations of the Preferred Alternative were modeled to provide a representation of the range of possible impacts (low and high emissions scenarios) and of impacts that could occur using various mitigation methods (see AQTSD Appendix J, Section J-2; TRC EC 2006). Impacts from the Preferred Alternative as described herein are those potentially occurring from the high emissions scenario (i.e., 250 wells developed per year, 50% directionally drilled wells, 80% Tier 0 [AP-42] [EPA 1995] and 20% Tier 1 drilling rig emission levels) with an 80% reduction in emission levels.

Near-field Impacts

The construction or production phase of the Preferred Alternative scenarios that would produce maximum emissions was identified by pollutant and analyzed. The maximum emissions configurations representative of the Preferred Alternative modeled were: PM_{10} and $PM_{2.5}$ using a 7.0-acre pad; SO_2 using directional drilling; and NO_2, CO, and HAP using 3,100 wells developed in the field at 16 well pads per section (40.0-acre surface well spacing). These configurations result in the maximum predicted impacts for the Preferred Alternative.

Direct project impacts of NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, and O_3 and a comparison of those impacts to NAAQS and WAAQS are presented in Appendix J, Tables J-1, J-2, J-3, J-4, J-5, and J-6, respectively. Appendix J, Table J-1 also presents a comparison of the maximum predicted NO_2 impacts resulting from production activities to the PSD Class II increment for NO_2. Predicted impacts from the Preferred Alternative source emissions would be below the applicable WAAQS and NAAQS and PSD increments.

Appendix J, Tables J-7 and J-8 summarize modeled HAP impacts based on emissions from Preferred Alternative sources.

Far-field Impacts

Direct project concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ were estimated at each of the eight Class I and sensitive Class II areas. The emissions modeled for Preferred Alternative scenarios are provided in Appendix J, Table J-9. Appendix J, Tables J-10, J-11, J-12, and J-13 present the maximum predicted concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. Appendix J, Tables J-14, J-15, and J-16 present the maximum modeled Preferred Alternative impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to PSD SILs and increments. As shown in these tables, pollutant concentrations resulting from all Preferred Alternative source emissions scenarios would be below applicable ambient air quality standards and PSD increments for both emissions scenarios. Potential NO_2 and PM_{10} concentrations may exceed proposed PSD Class I SILs at the Bridger Wilderness Area but would be below the significance levels at all other sensitive areas.

Direct visibility impacts from the Preferred Alternative are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for each development rate using both the FLAG and IMPROVE background visibility data. A summary of these impacts is provided in Appendix J, Tables J-17 (FLAG) and J-18 (IMPROVE). Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Direct project source emissions from the Preferred Alternative would not result in an increase in ANC above any LAC at the acid-sensitive lakes (Appendix J, Table J-19). Predicted maximum deposition impacts (Appendix J, Table J-20) from the Preferred Alternative are below the 0.005 kg/ha-yr DAT at all sensitive PSD Class I and Class II areas. The predicted N impacts (Appendix J, Table J-21) are above the 0.005 kg/ha-yr threshold at the Bridger and Popo Agie Wilderness Areas, and below the DAT at all other sensitive areas.

Mid-field Impacts

The maximum visibility impacts (dv) and estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at nearby Wyoming towns from Preferred Alternative scenarios are shown in Appendix J, Tables J-22 (FLAG) and J-23 (IMPROVE).

In-field Impacts

Model predicted concentrations of NO_2, SO_2, $PM_{10,}$ and $PM_{2.5}$ resulting from Preferred Alternative source emissions at locations within the JIDPA are shown in Appendix J, Table J-24. The estimated project-related impacts are below applicable ambient air quality standards. Potential in-field (near-field) concentrations are below PSD increments.

Preferred Alternative Air Quality Mitigation Measures

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5).

4.1.2.6 Cumulative Impacts

The CALPUFF model was used to quantify the impacts of NO_X, SO_2, PM_{10}, and $PM_{2.5}$ resulting from project sources, state-permitted sources, RFFA, and RFD located within the model domain (see Map 3.1). Project source emissions are described in Section 4.1.2 and quantified in Appendix J, Table J-9. State-permitted sources include NO_X, SO_2 and/or $PM_{10}/PM_{2.5}$ sources that began operation after January 1, 2001, and were permitted before June 30, 2003. June 30, 2003 became the end-date of the source inventory because the dispersion modeling analysis began on July 1, 2003. Sources permitted within the 18 months prior to January 1, 2001, but not yet operating were included as RFFA. RFD was defined as the undeveloped portion of 1) an approved NEPA project or 2) a proposed NEPA project for which quantified air emissions data were available at the time of the analysis. State-permitted, RFFA, and RFD emissions modeled in the cumulative analysis are quantified in Appendix J, Table J-9. RFD projects included in the cumulative analysis are listed in Appendix J, Table J-25. RFD projects were analyzed utilizing the maximum production scenario identified for each project. Emissions from field development (the construction phase) of RFD were not analyzed; rather, the combined emissions of all RFD operating at maximum production levels simultaneously was considered a conservative representation of domain-wide emissions. The development phases of individual RFD projects have the potential to cause or contribute to higher localized ambient air impacts than those demonstrated in this analysis. However, because RFD project development rates and schedules vary for each project and are difficult to define with certainty, it was determined that all emission sources operating at maximum production rates was the most reasonable representation of cumulative impacts occurring in the future when based on RFD information available at the time of analysis.

While there may be additional gas processing and/or transmission requirements due to development of this and other natural gas projects regionally and nationally, the potential effects of these developments are not quantified herein because these developments are speculative and would likely require WDEQ/AQD permit analysis if they eventually are proposed. A portion of the Powder River Basin Oil and Gas Development project, located more than 185 miles (>300 km) east-northeast of the JIDPA, is located within the far-field modeling domain defined in Map 3.1. A ratio of total Powder River Basin project field development equal to the geographical portion within the JIDPA far-field modeling domain was included as RFD in this analysis. The Powder River Basin project identified significant project-specific and cumulative impacts in the Bridger Wilderness and other sensitive areas analyzed for this project. Further information on air quality impacts associated with the PRBP may be found in the BLM (2002b).

Cumulative impacts were analyzed at each of the eight Class I and sensitive Class II areas, and at mid-field (regional communities) and in-field locations within the JIDPA. Ambient concentrations were estimated at each Class I and sensitive Class II area and at locations within the JIDPA. Acid deposition calculations were performed for each Class I and sensitive Class II area and at acid-sensitive lakes within these areas. Visibility impacts were computed for each Class I and sensitive Class II area and at mid-field (regional communities) locations.

Impacts Summary. The cumulative far-field modeling results for the range of project alternatives are provided in Appendix J, Tables J-26 through J-40. These tables present the estimated cumulative impacts resulting from project and regional source emissions. A discussion of the cumulative modeling results for each alternative is presented below.

Appendix J, Tables J-26, J-27, J-28, and J-29 present the maximum predicted cumulative impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. These maximum predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Appendix J, Tables J-30, J-31, and J-32 present the maximum modeled direct project and cumulative source impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to applicable PSD increments. As shown in these tables, cumulative pollutant concentrations from all project alternatives would be below applicable ambient air quality standards and PSD increments.

Estimated cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from project and regional source emissions are provided in Appendix J, Table J-33 for the FLAG background visibility data, and in Appendix J, Table J-34 for the IMPROVE background visibility data. As shown in these tables, cumulative visibility impacts from project alternatives were predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area and Wind River Roadless Area using the FLAG background data and at the Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Areas using the IMPROVE background visibility data. There were no predicted impacts above the 1.0-dv threshold at any of the other analyzed sensitive areas.

Appendix J, Table J-35 provides a summary of the maximum potential change in ANC at each of the analyzed sensitive lakes for each project alternative. Maximum modeled cumulative deposition impacts are provided in Appendix J, Table J-36 (S) and Table J-37 (N). Cumulative emissions from any of the project alternative sources combined with regional sources would not result in an increase in ANC above any LAC at the acid-sensitive lakes. In addition, predicted maximum cumulative S and N deposition impacts from all alternatives are well below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern at all sensitive PSD Class I and Class II areas. Further detail on cumulative S and N deposition impacts is provided in the air quality technical support document (TRC EC 2004).

Modeled cumulative visibility impacts at mid-field Wyoming regional community locations from project and regional source emissions are provided in Appendix J, Table J-38 for the FLAG background visibility data and in Table J-39 for the IMPROVE background visibility data. The number of days cumulative visibility impacts were predicted to be above the “just noticeable visibility change” (1.0-dv) threshold are shown in these tables for each project alternative scenario.

Appendix J, Table J-40 presents the maximum predicted cumulative impacts for each project alternative at in-field location compared to ambient air quality standards after adding monitored background concentrations. These estimated cumulative impacts are below applicable ambient air quality standards.

<u>No Action Far-field Cumulative Impacts</u>. Modeling was performed for the No Action Alternative to estimate cumulative impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ from non-project related source emissions consisting of RFD, RFFA, and state-permitted sources. Appendix J, Tables J-26, J-27, J-28, and J-29 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. These maximum predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Appendix J, Tables J-30, J-31, and J-32 present the maximum modeled cumulative No Action impacts of NO_2, SO_2, and PM_{10}, respectively, for comparison to applicable PSD increments. As shown in these tables, pollutant concentrations from No Action Alternative source emissions scenarios would be well below the applicable ambient air quality standards and PSD increments.

The visibility impacts resulting from cumulative No Action source emissions are provided in Appendix J, Table J-33 for the FLAG background visibility data and in Table J-34 for the IMPROVE background visibility data. Impacts are predicted to be above the “just noticeable visibility change” (1.0-dv) threshold at the Bridger Wilderness Area (3-day maximum) using both the FLAG and IMPROVE background visibility data. Visibility impacts at all other sensitive areas were predicted to be below the “just noticeable visibility change” threshold for all days. Current regional visibility trends are shown in Figures 3.2 through 3.4.

Cumulative acid deposition impacts at the seven sensitive lakes (Appendix J, Table J-35) are below the ANC change LACs. In addition, cumulative total N (Appendix J, Table J-36) and S deposition (Appendix J, Table J-37) are below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern.

<u>No Action Mid-field Cumulative Impacts</u>. The maximum visibility impacts at nearby Wyoming towns are shown in Appendix J, Table J-38 (FLAG) and Table J-39 (IMPROVE). The estimated number of days predicted to be above the “just noticeable visibility change” (1.0-dv) threshold and the maximum dv change are shown. The maximum number of days with a “just noticeable

visibility change" are predicted to occur at Big Piney (7-day maximum), approximately 18 miles northwest of the JIDPA.

<u>No Action In-field Cumulative Impacts</u>. Model predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from No Action cumulative source emissions at locations within the JIDPA are shown in Appendix J, Table J-24. The maximum impacts shown are compared to ambient air quality standards after adding monitored background concentrations. The estimated non-project impacts are below applicable ambient air quality standards.

<u>Proposed Action Far-field Cumulative Impacts</u>. Modeling was performed for the Proposed Action to estimate cumulative impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ from project and non-project related source emissions, consisting of RFD, RFFA, and state-permitted sources. Appendix J, Tables J-26, J-27, J-28, and J-29 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. These maximum predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Appendix J, Tables J-30, J-31, and J-32 present the maximum modeled cumulative impacts of NO_2, SO_2, and PM_{10}, respectively, from Proposed Action and regional sources for comparison to applicable PSD increments. As shown in these tables, pollutant concentrations from Proposed Action and regional source emissions scenarios would be below applicable ambient air quality standards and PSD increments.

The cumulative visibility impacts for the Proposed Action are provided in Appendix J, Table J-33 (FLAG) and in Table J-34 (IMPROVE). Visibility impacts are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area (7-day maximum) and Wind River Roadless Area (2-day maximum) using both the FLAG and IMPROVE background visibility data. Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Cumulative acid deposition impacts at the seven sensitive lakes (Appendix J, Table J-35) are below the ANC change LACs. In addition, cumulative total N (Appendix J, Table J-36) and S deposition (Appendix J, Table J-37) are well below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern.

<u>Proposed Action Mid-field Cumulative Impacts</u>. The maximum visibility impacts at nearby Wyoming towns are shown in Appendix J, Table J-38 (FLAG) and Table J-39 (IMPROVE). The estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold and the maximum dv change are shown The maximum number of days with a "just noticeable visibility change" are predicted to occur at Big Sandy (34-day maximum), approximately 16 miles northeast of the JIDPA.

<u>Proposed Action In-field Cumulative Impacts</u>. Model predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Proposed Action and regional source emissions at locations within the JIDPA are shown in Appendix J, Table J-24. The maximum impacts shown are compared to ambient air quality standards after adding monitored background concentrations. The estimated impacts are below applicable ambient air quality standards. Potential cumulative in-field (near-field) concentrations could exceed the PSD 24-hour PM_{10} increment but are below the annual PM_{10} increment and below the PSD increments for all other pollutants.

Preferred Alternative Far-field Cumulative Impacts. Modeling was performed for the Preferred Alternative to estimate cumulative impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ from project and non-project related source emissions, consisting of RFD, RFFA, and state-permitted sources. Appendix J, Tables J-26, J-27, J-28, and J-29 present the maximum predicted impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$, respectively, at the analyzed PSD Class I and sensitive PSD Class II areas. These maximum predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Appendix J, Tables J-30, J-31, and J-32 present the maximum modeled cumulative impacts of NO_2, SO_2, and PM_{10}, respectively, from Preferred Alternative and regional sources for comparison to applicable PSD increments. As shown in these tables, pollutant concentrations from Preferred Alternative and regional source emissions scenarios would be below applicable ambient air quality standards and PSD increments.

The cumulative visibility impacts for the Preferred Alternative are provided in Appendix J, Table J-33 (FLAG) and in Table J-34 (IMPROVE). Visibility impacts are predicted to be above the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area (6-day maximum) using both the FLAG and IMPROVE background visibility data. Visibility impacts at all other sensitive areas were predicted to be below the "just noticeable visibility change" threshold for all days.

Cumulative acid deposition impacts at the seven sensitive lakes (Appendix J, Table J-35) are below the ANC change LACs. In addition, cumulative total N (Appendix J, Table J-36) and S deposition (Appendix J, Table J-37) are well below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern.

Preferred Alternative Mid-field Cumulative Impacts. The maximum visibility impacts at nearby Wyoming towns are shown in Appendix J, Table J-38 (FLAG) and Table J-39 (IMPROVE). The estimated number of days predicted to be above the "just noticeable visibility change" (1.0-dv) threshold and the maximum dv change are shown. The maximum number of days with a "just noticeable visibility change" are predicted to occur at Big Piney (13-day maximum), approximately 18 miles northwest of the JIDPA.

Preferred Alternative In-field Cumulative Impacts. Model predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ resulting from Preferred Alternative and regional source emissions at locations within the JIDPA are shown in Appendix J, Table J-24. The maximum impacts shown are compared to ambient air quality standards after adding monitored background concentrations. The estimated cumulative impacts are below applicable ambient air quality standards and PSD increments.

Cumulative Impacts for Other Project Alternatives. The predicted cumulative impacts from all other project alternatives are well below the applicable ambient air quality standards and PSD Class I increments. Potential cumulative in-field (near-field) concentrations from other project alternatives could exceed the PSD 24-hour PM_{10} increment but are below the annual PM_{10} increment and below the PSD increments for all other pollutants. Estimated acid deposition impacts at the seven sensitive lakes are below the ANC change LACs. In addition, cumulative total N and S depositions are well below the 5 kg/ha-yr (S) and 3 kg/ha-yr (N) levels of concern. Predicted visibility impacts from the other project alternatives are less than or equivalent to the Proposed Action Alternative and greater than the Preferred Alternative. The cumulative far-field modeling results for all project alternatives are summarized in Appendix J, Tables J-26 through J-40.

4.1.2.7 Unavoidable Adverse Impacts

Some increase in air pollutant emissions would occur as a result of the Proposed Action and alternatives. Near-field impacts from these emissions are predicted to be below applicable significance thresholds. However, there is a potential for direct and cumulative visibility impacts to exceed visibility levels of concern within PSD Class I Bridger Wilderness Area and deposition thresholds within Bridger Wilderness Area, Popo Agie Wilderness Area, and Wind River Roadless Area.

4.1.3 Topography

Impacts to topography would be considered significant if disturbance permanently inhibited or substantially altered surface drainage patterns (e.g., new head-cutting and/or gully formation inhibiting surface runoff to areas where wetlands or riparian areas depend on it, changes that substantially redirect surface runoff). Project impacts to topography are assumed to be proportional to the volume of surface disturbance (i.e., increased surface disturbance would correspond to an increase in the potential for altered surface drainage patterns). Specific impacts would include changes to the landscape due to cut-and-fill (surface-leveling) activities used to construct well pads, access roads, and other facilities; road and pipeline crossings of channels; and slope and drainage alterations. The landscape and surface drainage alterations associated with this project would require specific mitigation as identified in Appendices A, B, and C.

4.1.3.1 No Action Alternative

Under the No Action Alternative, impacts to topography would be limited to the existing developments for 497 well pads and associated facilities—4,209 acres total disturbance, of which 2,811 acres would be short term and 1,409 acres would be long term over the LOP (see Table 2.2). No significant impacts are anticipated. The duration of impacts would be approximately 63 years (see Table 2.1) and until areas are adequately reclaimed (see Appendix B).

4.1.3.2 The Proposed Action

An estimated maximum of 20,409 acres of total disturbance would occur under the Proposed Action (see Table 2.3), 14,388 acres of which would be short term, because surface disturbance areas not needed for operations would be recontoured and reseeded within 2 to 4 years after disturbance (e.g., portions of well pads and road ROWs and entire pipeline ROW areas). Long-term LOP disturbance is estimated at 6,043 acres and is anticipated to last for approximately 76 years and until successful reclamation is achieved (see Table 2.1). An approximate 385% increase in total disturbance and 329% increase in LOP disturbance above the No Action Alternative would occur under the Proposed Action; impact duration would be extended at least an additional 13 years (76-year LOP), and significant impacts are anticipated.

4.1.3.3 Alternative A

The types of impacts to topography under Alternative A would be similar to those described for the Proposed Action, except that impacts may be further amplified if BLM standard stipulations (particularly those regarding steep slopes and drainage channels) are excepted (see Appendix A). Additionally, impacts would occur in some areas that would be avoided under the Proposed Action (i.e., greater sage-grouse lek, raptor nest, and Sand Draw buffers). Significant impacts are anticipated.

4.1.3.4 Alternative B

An estimated maximum of 7,431 acres of total disturbance would occur under Alternative B (see Table 2.4), 4,848 acres of which would be short term. LOP disturbance would be 2,602 acres and is anticipated to last for approximately 105 years, plus the time needed for successful reclamation (see Table 2.1). An approximate 77% increase in total disturbance and 85% increase in LOP disturbance above the No Action Alternative would occur under Alternative B; impact duration would be extended at least an additional 42 years (105-year LOP). No significant impacts are anticipated.

4.1.3.5 BLM Preferred Alternative

Under the Preferred Alternative, an estimated maximum of 14,030–20,334 acres of disturbance would occur (see Table 2.5), 9,782–14388 acres of which would be short term, because surface disturbance areas not needed for operations would be recontoured and reseeded within 2 to 4 years after disturbance (e.g., portions of well pads, road ROWs, and entire pipeline ROW areas). Long-term LOP disturbance is estimated at 4,267–6,020 acres and is anticipated to last for approximately 76 years and until successful reclamation is achieved (see Table 2.1). An approximate 233–386% increase in total disturbance and 203–327% increase in LOP disturbance above the No Action Alternative would occur under the Preferred Alternative; impact duration would be extended at least an additional 13 years (76-year LOP), and significant impacts such as those described under Section 4.1.3 are anticipated.

Impacts to topography would be similar to those of the Proposed Action, except that the BLM Preferred Alternative would limit total surface disturbance at any given time to a maximum of 14,030 acres. Additional mitigation measures would also be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5). Even with the application of these measures, significant impacts may occur to topography for the LOP.

4.1.3.6 Cumulative Impacts

The CIAA for topography includes the combined 10 watersheds that drain the JIDPA, which encompass approximately 210,300 acres. Approximately 1.6% (3,355 acres) of the CIAA has been previously disturbed (see Table 3.11).

RFD (total new surface disturbance) for the CIAA outside the JIDPA is estimated at 594 acres, primarily from gas-related development in the Pinedale Anticline Natural Gas Field (see Section 4.1.7). Approximately 38% (228 acres) of the RFD would occur in the Expanded Sand Draw-Alkali Creek watershed. RFD for the North Alkali Draw watershed is estimated at 168 acres; Southeast New Fork River is estimated at 126 acres; the Big Sandy River is estimated at 54 acres; and the Upper Eighteenmile Canyon is estimated at 18 acres.

Maximum cumulative disturbance (i.e., the combined existing, proposed [under the Proposed Action, Alternative A, and the BLM Preferred Alternative], and RFD disturbance) could be on the order of 22,900 acres (10.9% of the CIAA) in the combined watersheds. Maximum cumulative disturbance would be greatest in the Expanded Sand Draw-Alkali Creek watershed, and would be primarily attributable to gas development (see Section 4.1.7). The Long Draw watershed that drains 16% of the JIDPA would experience the second greatest amount of cumulative disturbance. The closed basin watersheds—Jonah Gulch and 140401040603—would likely only experience a small increase in cumulative disturbance. Significant cumulative impacts to topography are anticipated under the Proposed Action and Alternative A, with somewhat less impact under the BLM Preferred Alternative because of the limit on disturbance allowable at any one time. Alternative B would result in the least impact on topography due to the associated reduction in surface disturbance.

4.1.3.7 Unavoidable Adverse Impacts

Unavoidable adverse impacts to topography would include long-term changes in landform throughout the JIDPA. Because reclamation activities would be performed such that the reclaimed landscape emulates predisturbance conditions, no notable permanent changes (post-LOP) in topography are anticipated. Minor differences from the predisturbance condition would be present, but the overall integrity to pre-existing topography would be retained.

4.1.4 Mineral Resources

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and the land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with mineral resources:

- to maintain or enhance opportunities for mineral exploration and development, while protecting other resource values;
- to provide for oil and gas leasing, exploration, and development while protecting other values;
- to provide saleable mineral materials (e.g., sand, gravel) in convenient locations for users, while protecting other resources;
- to consider the conservation and enhancement of natural resources with the economic benefits of resource development;
- to coordinate land use decisions with economic factors and needs;
- to plan land use consistent with the orderly development, use, and conservation of resources while preserving environmental quality; and
- to plan uses that encourage energy conservation.

The primary project impact to mineral resources would be from the depletion of recoverable gas and oil reserves from the Lance Pool and possibly other formations underlying the JIDPA (Table 4.5), and significant impacts are anticipated under most alternatives because these are non-renewable resources. The economic impacts from natural gas and oil recovery are described in Section 4.4.

Because the project (under any alternative) is not anticipated to interfere with the recovery of other minerals (i.e., sand and gravel), these resources would remain available for recovery. Therefore, no impacts to other minerals are anticipated and they are not further discussed.

Table 4.5. Anticipated Gas and Condensate Recovery Volumes for Each Alternative, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Alternative	Approximate Natural Gas Recovered[1] (billion cubic feet [BCF])	Approximate Condensate (Oil) Recovered[1] (MBO)	Recovery Volumes Compared to Proposed Action	
			Gas (BCF)	Oil (MBO)
No Action	3,366	31.98	(4,581)	(43.52)
Proposed Action[2]	7,947	75.50	0	0
Alternative A	8,191	77.81	+244	+2.31
Alternative B[2]	6,124	58.18	(1,823)	(17.32)
Preferred Alternative[2]	4,824–7,947	45.83–75.50	(3,123)–0	(29.67)–0

[1] Assumes approximately 12,800 BCF of natural gas and 99.75 MBO of condensate are present beneath the JIDPA.
[2] Does not fully account for losses/unrecovered resources associated with undeveloped wells (assumed to be uneconomic).

4.1.4.1 No Action Alternative

Under the No Action Alternative, an estimated 3,366 BCF of natural gas and 31.98 MBO would be recovered. Compared to the Proposed Action, this would leave approximately 4,581 BCF of gas and 43.52 MBO unrecovered (see Table 4.5).

The No Action Alternative could result in substantial volumes of unrecovered resource. Because large volumes of the resources would remain in place and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.2 The Proposed Action

Implementation of the Proposed Action would result in an estimated total production of natural gas and condensates (oil) from the field of 7,947 BCF and 75.50 MBO, respectively. These amounts represent 4,581 BCF more gas and 43.52 MBO more oil than would be recovered under the No Action Alternative. Because these extracted mineral resources would no longer be available, significant effects to mineral resources would occur.

4.1.4.3 Alternative A

Under Alternative A, impacts to oil and gas reserves would be the recovery of 8,191 BCF of gas and 77.81 MBO (see Table 4.5). These amounts represent an increase in 4,825 BCF of gas and 45.83 MBO of oil that would be recovered under the No Action Alternative. Compared to the Proposed Action, an additional 244 BCF of gas and 2.31 MBO would be recovered. Because the extracted mineral resources would no longer be available, significant effects to mineral resources and future consumers would occur.

4.1.4.4 Alternative B

Under Alternative B, 6,124 BCF of natural gas and 58.18 MBO would be produced—approximately 2,758 BCF of gas and 26.20 MBO more than would be recovered under the No Action Alternative. Compared to the Proposed Action, Alternative B would leave approximately 1,823 BCF of gas and 17.32 MBO unrecovered. Because considerable unrecovered reserves would remain available and could be potentially extracted at a future date, no significant impacts are anticipated.

4.1.4.5 BLM Preferred Alternative

Under the Preferred Alternative, impacts on gas and oil resources would equal that of the Proposed Action if the Operators maximize ongoing reclamation as described in Section 2.4.5 (i.e., 4,824–7,947 BCF of gas and 45.83–75.50 MBO would be produced). An estimated 1,458–4,581 BCF more gas and 13.85–43.52 MBO more oil would be produced than for the No Action Alternative.

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5); however, because most natural gas resources would be recovered and would no longer be available, significant effects would occur.

4.1.4.6 Cumulative Impacts

The CIAA for mineral resources is the composite Jonah Field, which includes the original Jonah Prospect field, the Jonah II project area, and the JIDPA (see Map 3.5). This project is proposed in part to maximize natural gas and condensate recovery from the known reserves in this area. Because additional development beyond that described herein is not anticipated in the CIAA, cumulative impacts to mineral resources would be the same as described for the No Action Alternative, Proposed Action, Alternatives A and B, and the BLM Preferred Alternative.

4.1.4.7 Unavoidable Adverse Impacts

Unavoidable adverse impacts to mineral resources would include the permanent loss of the extracted mineral resource (e.g., natural gas), which would no longer be available. This would occur under the Proposed Action, Alternative A, and the BLM Preferred Alternative. Under the No Action Alternative and Alternative B there would be less-than-complete recovery of resources, which would either: 1) necessitate developing similar resources elsewhere with possible adverse effects; 2) delay the recovery of these resources until some unknown time in the future; or 3) result in the loss of royalties. These effects could lead to unavoidable adverse impacts to other resources in the future.

4.1.5 Geologic Hazards

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with geologic hazards:

- to protect the health and safety of the public and the well-being of sensitive natural resources,
- to minimize the loss of life and property from natural hazards, and
- to generate and provide data on development limitations.

Any impacts that would lead to the inability of management agencies to achieve these goals/objectives would be considered a significant impact.

Potential impacts associated with geologic hazards include impacts associated with subsidence, earthquakes, and landslides. The depth of gas reserves in the JIDPA and the lack of underground mines in the area negate the potential for subsidence. There are no known active faults within the JIDPA. No known landslides occur in the JIDPA, so none of the alternatives would be affected by landslides. With the application of mitigations (see Appendices A and C), impacts are anticipated to be less than significant under all alternatives, and no further alternative-specific impact analyses are discussed.

Under the BLM Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5).

The CIAA area for geologic hazards includes the composite Jonah Field, including the original Jonah Prospect field, the Jonah Field II project area, and the JIDPA (see Map 3.5), and no further development beyond this proposed project is planned for the area. Development in this area is not likely to affect or be affected by geologic hazards. Therefore, cumulative impacts would be the same as described above for the proposed project.

No unavoidable adverse impacts would occur due to geologic hazards.

4.1.6 Paleontological Resources

The PFO and RSFO RMP (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with paleontological resources:

- to expand the opportunities for scientific study and educational and interpretive uses of paleontological resources,
- to protect and preserve important paleontological resources and/or their historic record for future generations, and
- to resolve conflicts between paleontological resources and other resource uses.

Under all alternatives, direct impacts to paleontological resources would include damage or destruction of fossils and associated data due to field development/surface disturbance for well pads, roads, pipelines, ancillary facilities, etc. For the purpose of this analysis, it is assumed that increases in surface disturbance correspond to an increase in the potential for impacts to paleontological resources. Indirect impacts would include loss from unauthorized collection or vandalism which, in turn, would result in a loss of the opportunity to expand scientific study and educational and interpretive uses of these resources. However, surface-disturbing activities could uncover fossils of significant scientific importance that otherwise would have remained buried and unavailable for scientific study.

The important fossil record of the Green River Basin is well known (Grande 1984; BLM 1992) (see also Table 3.9). The recent discovery of Pleistocene horse bones (tentative identification) during well pad construction in the JIDPA affects potential future paleontological mitigation procedures for the area because Pleistocene paleontological materials were previously unknown for the JIDPA. Other geologic formations within the JIDPA are known to contain significant fossils throughout their occurrence in the Green River Basin. Therefore, significant fossils likely occur in the JIDPA. To lessen impacts, mitigation measures including avoidance, survey, monitoring, and collection would be used under all alternatives (see also Appendices A and C). As additional mitigation, a synthesis and/or overview of paleontological resources found within the JIDPA could be generated. In areas of paleontological sensitivity, a determination would be made by the BLM as to whether a survey by a qualified paleontologist is necessary prior to the disturbance.

4.1.6.1 No Action Alternative

Under the No Action Alternative, potential impacts to paleontological resources would be primarily associated with existing surface disturbances (4,209 acres) related to currently approved field development activities. Indirect impacts associated with unauthorized collection or vandalism would continue for the LOP.

4.1.6.2 The Proposed Action

Direct impacts under the Proposed Action would be increased from those of the No Action Alternative because up to 20,409 acres of disturbance would occur—16,200 acres more than for the No Action Alternative (see Table 2.3). There would be an increase in human activity and it would occur for a longer duration (approximately 13 years longer than No Action), resulting in more potential for both vandalism and discovery.

4.1.6.3 Alternative A

Potential direct impacts to paleontological resources under Alternative A would be similar to those described for the Proposed Action except that under Alternative A, some disturbance would occur in areas such as along Sand Draw that would be avoided under the Proposed Action. Indirect impacts would be increased from the No Action Alternative due to the increase in human activity, and these indirect impacts would occur for a longer duration, resulting in more potential for both vandalism and discovery (see Table 2.3).

4.1.6.4 Alternative B

Direct and indirect impacts to paleontological resources under Alternative B would be increased from those of the No Action Alternative due to the increase in total surface disturbance of 3,222 acres and the increased human presence. Duration of the impacts would be up to 42 years longer, resulting in more potential for both vandalism and discovery.

4.1.6.5 BLM Preferred Alternative

Under the Preferred Alternative, impacts to paleontological resources would be increased from those of the No Action Alternative. The Preferred Alternative would result in 9,821–16,125 acres of additional surface disturbance and 2,858–4,611 acres more LOP disturbance. The Preferred Alternative would have a direct impact duration of approximately 13 years longer than the No Action Alternative. Total surface disturbance would be comparable to that of the Proposed Action if the Operators maximize ongoing reclamation as described in Section 2.4.5; however, under the Preferred Alternative, additional inventory and mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5).

4.1.6.6 Cumulative Impacts

The CIAA for paleontological resources is a 310,000-acre area (surrounding the JIDPA (see Map 3.5). Approximately 1.1% (3,331 acres) of the CIAA has been previously disturbed, much of which is from natural gas well pads, roads, and pipelines in the JIDPA (i.e., currently approved oil and gas development activities). Other activities include oil and gas development in the Pinedale Anticline Field, livestock grazing, and recreation. Livestock grazing and recreation have minimal impacts on paleontological resources, other than the possibility of increasing opportunities for illegal collecting and/or vandalism.

RFD (new surface disturbance) for the portion of the CIAA outside the JIDPA is estimated at 594 acres, primarily from gas-related development in the Pinedale Anticline Natural Gas Field. Maximum cumulative disturbance (i.e., the combined existing, proposed [the Proposed Action, Alternative A, and the BLM Preferred Alternative], and RFD disturbance) could be on the order of 22,900 acres (7.4% of the CIAA). Alternative B would have less activity and surface disturbance, therefore, would have a reduced potential for cumulative impacts. Cumulative impacts to paleontological resources would be of the same type as those described for the action alternatives; however, the potential for significant cumulative impacts is unknown because little paleontological inventory or evaluation has been conducted in the JIDPA.

4.1.6.7 Unavoidable Adverse Impacts

Unavoidable adverse impacts to paleontological resources include the fossil resources that may be inadvertently damaged or destroyed by surface-disturbing activities and those potentially lost through illegal collecting and/or vandalism.

4.1.7 Soils

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with soils:

- to stabilize and conserve soils;
- to increase vegetative production;
- to maintain or improve surface water and groundwater quality;
- to protect, maintain, or improve wetlands, floodplains, and riparian areas;
- to minimize topsoil erosion;
- to maintain or increase highly diverse native plant communities; and
- to consider the suitability of soil composition in all land use decisions.

Impacts to soils would be considered significant if a reduction in soil productivity and/or increased erosion would prevent successful reclamation and/or if disturbance or other activities resulted in a violation of the aforementioned land use objectives. Impacts to soils are assumed to be proportional to the amount of new surface disturbance for all alternatives (i.e., increased disturbance would result in a proportionally increased potential for adverse impacts to soils). Under the various alternatives, Operators would implement various management requirements/ mitigation measures (see Appendices A and C); therefore, impacts to soils would also be dependent on the effectiveness of this mitigation. Cumulative acreage of disturbance in each CIAA watershed and percent of watersheds affected are shown in Tables 4.6 and 4.7. respectively. Significant impacts to soils resulting from surface disturbance are anticipated under all alternatives.

Direct impacts to soils would include removal of vegetation, exposure of the soil, mixing of soil horizons, loss of topsoil productivity, soil compaction, and increased susceptibility to wind and water erosion. These impacts could, in turn, result in increased runoff, erosion, and sedimentation. Increased surface runoff and erosion would occur primarily in the short term and would decline in time due to natural stabilization through particle aggregation, soil structure development, and armoring. Short-term control of surface runoff would be dependent on the success and implementation of reclamation and revegetation efforts described in Reclamation Plan and Surface Use Plans and Plans of Development prepared for each Application for Permit to Drill (APD) and/or ROW application, and Storm Water Pollution Prevention Plans (SWPPPs) (see also Appendix B). Following application of reclamation and revegetation procedures, the susceptibility of disturbed areas to soil erosion would be minimized for both the short term and for the LOP.

Because the extent of erosion in the JIDPA under any alternative is undefined, the BLM determined that modeling would be performed to quantify sediment loss and transport (load) at the JIDPA boundary. The modeling looked at the sediment loss experienced during individual storms of varying size, with the amount of erosion experienced proportional to the size of the storm. Modeling was done for two alternatives analyzed in this EIS: the No Action Alternative and the Proposed Action.[1] Potential impacts were extrapolated for the other project alternatives. Modeled impacts for each action alternative were assessed by looking at the total sediment loss (in kilograms) resulting from new disturbance above and beyond that of the No Action Alternative. Table 4.8 shows the total sediment loss, by watershed, for each alternative for 5-year and 150-year storms. Complete results of the modeling are reported in Appendix E, *Erosion, Sediment Transport, and Salinity Modeling Technical Report: Jonah Infill Drilling Project, Sublette County, Wyoming* (HydroGeo 2005).

Most soils in the JIDPA have a naturally high erosion potential and generally have limited rehabilitation potential because of one or more characteristics including thin soils, shallow depth to bedrock, excess salts, excess sand and/or small stones, clayey textures, and excess lime.

Concentrating development actions at larger well pads would have increased site-specific effects on overland flow patterns, groundwater infiltration (reduced on compacted areas), and runoff volumes (increased rates and potential erosion and sedimentation). Additionally, if surface disturbance is concentrated in any one watershed, increased potential erosion and runoff-related effects may occur, possibly requiring the need for special treatments to be specified in APD approvals. Estimates of potential total and LOP disturbance associated with the various project alternatives within each project-affected watershed are presented in Tables 4.6–4.8 and are discussed under each alternative.

The potential for contamination of soils due to the accidental discharge would be limited by appropriate project implementation procedures and the remedial measures applied as specified in SPCCPs (see Appendix B). The following analyses show that the Proposed Action and alternatives generally are compatible with existing management goals/objectives; however, significant impacts to soils are anticipated in the short term in and down-channel from the JIDPA. Mitigation measures (see Appendices A and C) would be required under all project alternatives to minimize impacts to soil resources.

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[1] In addition to the No Action Alternative and the Proposed Action, HydroGeo (2005) modeled an undisturbed condition and the Preferred Alternative as configured in the JIDP DEIS.

4.1.7.1 No Action Alternative

Under the No Action Alternative, no additional activities would occur that would potentially affect soil resources other than those previously approved for the area (BLM 1998b, 2000b)—2,811 acres of short-term and 1,409 acres of LOP disturbance, or 9.2% and 4.6% of the JIDPA, respectively. Total disturbance would equal 4,209 acres. The duration of impacts would be approximately 63 years and until areas are adequately reclaimed. No additional significant impacts to soils beyond those of previously authorized actions are expected under the No Action Alternative.

4.1.7.2 The Proposed Action

Compared to the No Action Alternative, the Proposed Action would result in an estimated increase of 16,200 acres of new disturbance, for a total disturbance of 20,126 acres in the JIDPA (66.0% of the JIDPA), and an additional 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total project-specific existing and new disturbance under the Proposed Action would be 20,409 acres (see Table 4.6). Approximately 70.4% (14,388 acres) of this disturbance would be reclaimed and reseeded as soon as practical after disturbance (see Appendix B). Disturbance would not occur all at once, but would increase as development occurs (for approximately 13 years). Simultaneously, disturbance would decrease in some areas as some disturbed lands are reclaimed. Significant impacts to soils are anticipated under the Proposed Action; however, the magnitude of impacts to soil resources would depend on how much disturbance is present at any one time and the rate of reclamation. Approximately 6,043 acres would be disturbed for the LOP (i.e., approximately 76 years and until successful reclamation is achieved).

As shown in Table 4.8, under the Proposed Action, a 5-year storm results in an 802% increase in soil loss over the No Action Alternative, while a 150-year storm results in a 55% increase over the No Action Alternative. (In general, the 150-year storm is such a powerful event that erosion will happen whether or not ground has been disturbed; thus, the No Action Alternative itself sees relatively high erosion rates, and the total increase under the Proposed Alternative is a smaller percentage.) In terms of actual soil loss, the 5-year storm yields 224,000 kilograms more than the No Action Alternative, and the 150-year storm yields approximately 5.1 million kilograms more than the No Action Alternative.

The greatest impacts occur to the watersheds contributing to the Big Sandy River (see Table 4.8). The Long Draw and Bull Draw watersheds account for 79% of the 5-year soil loss, and 72% of the 150-year soil loss. Sand Draw, which accounts for 45% of the JIDPA area, yields relatively little sediment under any storm condition: no sediment during the 5-year event, and only 10% of the 150-year soil loss.

No formal estimates of disturbance to the 17 soil map units defined for the JIDPA (see Map 3.7) are provided herein due to the variability and unknown locations for much of the proposed development. Estimates of the types of soils most likely to be disturbed are based on the coarse-scale soil map units (see Map 3.6). The SU05 and SU03 soil mapping units comprise over 99% of the JIDPA. These soil units are impacted approximately the same under the Proposed Action. During the 5-year storm, 59% of the lost soil is from soil mapping unit SU03 and 41% of the lost soil is from soil mapping unit SU05. During the 150-year storm, 43% is from SU03 and 57% is from SU05.

Table 4.6. Cumulative Acreage of Disturbance in each CIAA Watershed and Including RFD, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Watershed/ Major River Drainage	Total Acreage of Watershed	Acres of Watershed within JIDPA	Existing Disturbance in CIAA but Outside JIDPA	RFD	JIDP Disturbance											
					No Action[1]			Proposed Action and Alternative A[2] (3,100 Wells/Pads)			Alternative B[3] (3,100 Wells/497 Pads)			Preferred Alternative[4] (3,100 Wells/Pads)		
					JIDP Total	LOP	Cumulative[5]	JIDP Total	LOP	Cumulative[5]	JIDP Total	LOP	Cumulative[5]	JIDP Total	LOP	Cumulative[5]
Green River/New Fork River																
Expanded Sand Draw-Alkali Creek	22,931	13,725	327	228	1,800	607	2,355	9,057	2,682	9,612	3,250	1,143	3,805	6,220–9,057	1,841–2,682	6,775–9,612
Granite Wash	12,212	1,312	36	0	172	58	208	866	256	902	311	109	347	595–866	175–256	630–902
Reduced Upper Alkali Creek-Green River	26,797	3,782	239	0	496	167	735	2,496	739	2,735	896	315	1,135	1,714–2,496	507–739	1,953–2,735
Upper Eighteenmile Canyon	35,212	1,958	477	18	257	87	752	1,292	386	1,787	464	163	959	887–1,291	265–386	1,382–1,787
Southeast New Fork River-Blue Rim	11,746	0	23	126	0	0	149	0	0	149	0	0	149	0	0	149
North Alkali Draw	15,911	0	101	168	0	0	269	0	0	269	0	0	269	0	0	269
Subtotal	124,809	20,776	1,203	540	2,725	919	4,469	13,710	4,063	15,453	4,920	1,731	6,663	9,416–13,710	2,788–4,063	11,159–15,453
Big Sandy River																
Big Sandy River-Bull Draw	19,760	3,630	217	54	476	160	747	2,395	709	2,666	860	302	1,131	1,645–2,395	486–709	1,915–2,666
Long Draw	18,521	5,028	281	0	660	222	941	3,318	982	3,599	1,191	419	1,472	2,278–3,318	674–982	2,559–3,599
Subtotal	38,281	8,658	498	54	1,136	382	1,688	5,713	1,691	6,265	2,050	721	2,603	3,923–5,713	1,160–1,691	4,475–6,265
Closed Basins																
Jonah Gulch	22,652	318	127	0	42	14	169	210	62	337	75	26	202	144–210	42–62	271–337
1.40401E+11	24,558	747	122	0	98	33	220	493	146	615	177	62	299	339–493	100–146	460–615
Subtotal	47,210	1,065	249	0	140	47	389	703	208	952	252	89	501	483–703	142–208	731–952
Total[6]	210,300	30,500	1,950	594	4,001	1,348	6,545	20,126	5,962	22,670	7,223	2,541	9,767	13,822–20,126	4,090–5,962	16,364–22,671
Additional associated disturbance[7]					208	61	208	283	81	283	208	61	208	208	61	208
Grand Total[6]			--	--	4,209	1,409	6,753	20,409	6,043	22,953	7,431	2,602	9,975	14,030–20,334	4,151–6,023	16,574–22,878
Percent disturbance of entire CIAA			0.9	0.3	1.9	0.6	3.2	9.6	2.9	10.9	3.4	1.2	4.8	6.79.7	2.0–2.9	7.9–10.9

[1] Assumes total and LOP disturbance as currently authorized.
[2] Assumes 20,126 acres of total and 5,962 acres of LOP disturbance in the JIDPA.
[3] Assumes 7,223 acres of total and 2,539 acres of LOP disturbance in the JIDPA.
[4] Assumes 13,822 acres of total and 4,090 acres of LOP disturbance in the JIDPA. With successful reclamation, could increase to 20,126 acres of total and 5,962 acres of LOP disturbance.
[5] Cumulative disturbance = New + existing + RFD.
[6] Columns may not total due to rounding error.
[7] Assumes new total and LOP disturbance associated with selected ancillary facilities which may be constructed outside the JIDPA (e.g., Burma Road upgrade, compressor stations).

Table 4.7. Percent of Watersheds Affected, Including Existing Disturbance, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Watershed/ Major River Drainage[2]	Total Acreage of Watershed	Percent of Watershed in JIDPA	Percent of Entire Watershed Currently Disturbed[2]	No Action			Proposed Action and Alternative A (3,100 Wells/ 3,100 Pads)			Alternative B (3,100 Wells/ 497 Pads)			Preferred Alternative (3,100 Wells/ 3,100 Pads)		
				JIDP Total [3]	LOP[3]	Cumulative	JIDP Total [3]	LOP[3]	Cumulative	JIDP Total [3]	LOP[3]	Cumulative	JIDP Total [3]	LOP[3]	Cumulative
Green River/New Fork River															
Expanded Sand Draw-Alkali Creek	22,931	59.9	4.2	7.8	2.6	10.3	39.5	11.7	41.9	14.2	5.0	16.6	27.1–39.5	8.0–11.7	29.5–41.9
Granite Wash	12,212	10.7	0.3	1.4	0.5	1.7	7.1	2.1	7.4	2.5	0.9	2.8	4.9–7.1	1.4–2.1	5.2–7.4
Reduced Upper Alkali Creek-Green River	26,797	14.1	1.3	1.9	0.6	2.7	9.3	2.8	10.2	3.3	1.2	4.2	6.4–9.3	1.9–2.8	7.3–10.2
Upper Eighteenmile Canyon	35,212	5.6	1.7	0.7	0.2	2.1	3.7	1.1	5.1	1.3	0.5	2.7	2.5–3.7	0.8–1.1	3.9–5.1
Southeast New Fork River-Blue Rim	11,746	0.0	0.2	--	--	1.3	--	--	1.3	--	--	1.3	0	0	1.3
North Alkali Draw	15,911	0.0	0.6	--	--	1.7	--	--	1.7	--	--	1.7	0	0	1.7
Big Sandy River															
Big Sandy River-Bull Draw	19,760	18.4	1.1	2.4	0.8	3.8	12.1	3.6	13.5	4	1.5	5.7	8.3–12.1	2.5–3.6	9.7–13.5
Long Draw	18,521	27.1	0.7	3.6	1.2	5.1	17.9	5.3	19.4	6.4	2.3	7.9	12.3–17.9	3.6–5.3	13.8–19.4
Closed basins															
Jonah Gulch	22,652	1.4	1.0	0.2	0.1	0.7	0.9	0.3	1.5	0.3	0.1	0.9	0.6–0.9	0.2–0.3	1.2–1.5
140401040603	24,558	3.0	0.7	0.4	0.1	0.9	2.0	0.6	2.5	0.7	0.3	1.2	1.4–2.0	0.4–0.6	1.9–2.5

[1] Percent of watershed affected is calculated using potential acreage affected (refer to Table 4.6) divided by the total watershed acreage multiplied by 100.
[2] As described in Table 3.11.
[3] Provides percent of the watershed within the JIDPA that would be disturbed.

Table 4.8. Total Sediment Loss in Kilograms by Alternative, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

	Return Period 5 Years				Return Period 150 Years			
	No Action[1] (4,209 acres)[3]	Proposed Action[1] Alternative A[1] (20,409 acres)	Alternative B[2] (7,431 acres)	Preferred Action[2] (14,030–20,334 acres)	No Action[1] (4,209 acres)[3]	Proposed Action[1] Alternative A[1] (20,409 acres)	Alternative B[2] (7,431 acres)	Preferred Action[2] (14,030–20,334 acres)
Green River/New Fork River								
Upper Eighteenmile Canyon	406	3,154	965	2,072	240,984	341,313	261,403	301,807
Granite Wash	27	2,430	516	1,484	286,727	478,232	325,702	402,824
Expanded Sand Draw-Alkali Creek	0	0	0	0	439,567	1,433,122	641,774	1,041,894
North Alkali Draw	7,485	26,512	11,357	19,020	1,156,586	1,624,999	1,251,917	1,440,554
Big Sandy River								
Big Sandy River-Bull Draw	2,944	36,798	9,834	23,467	1,835,340	2,878,764	2,047,696	2,467,900
Long Draw	15,331	175,512	47,931	112,438	5,181,675	7,472,309	5,647,861	6,570,337
Closed Basins								
140401040603	1,688	7,110	2,791	4,975	182,220	238,606	193,696	216,403
Total	**27,881**	**251,516**	**73,395**	**163,456**	**9,323,099**	**14,467,345**	**10,370,048**	**12,441,719**
Total Increase over No Action	**0**	**223,635**	**45,514**	**135,575**	**0**	**5,144,246**	**1,046,949**	**3,118,620**

[1] Based on erosion and sediment transport modeling, HydroGeo (2005); see Appendix E.
[2] No modeling conducted. Interpolated based on surface area impacts as a percentage of Proposed Action.
[3] Acreage refers to maximum amount of acreage disturbed at any one time under each alternative

4.1.7.3 Alternative A

Implementation of Alternative A is anticipated to result in the same types and acreage of impacts and surface disturbance as the Proposed Action (see Tables 4.6 and 4.7) and would result in increased soil impacts and disturbance over those of the No Action Alternative. However, because selected Operator-committed and BLM-required practices would not be implemented (e.g., avoidance of steep slopes and drainage buffers), significant impacts are more likely to occur under this alternative. Development of natural gas resources in these areas could result in significant impacts to soil resources, particularly in the Long Draw and Bull Draw watersheds, due to increased erosion and/or sedimentation (see Table 4.8). As with the Proposed Action, not all areas would be disturbed at the same time, rather, disturbance would accumulate as development occurs. As with the Proposed Action, the rate of development would be 250 wells/year, resulting in a LOP of approximately 76 years or until successful reclamation.

4.1.7.4 Alternative B

Compared to the No Action Alternative, Alternative B would result in an estimated increase of 3,222 acres of new disturbance, for a total disturbance of 7,223 acres in the JIDPA (23.7% of the JIDPA), and an additional 208 acres for ancillary facilities that may be constructed outside the JIDPA (see Table 4.6). Existing and new disturbance under Alternative B would total 7,431 acres. Disturbance would not occur all at once, but would increase as development occurs (for approximately 42 years). Simultaneously, disturbance would decrease in some areas as some disturbed lands are reclaimed. Significant impacts to soils are anticipated under Alternative B; however, the magnitude of impacts to soil resources would depend on how much disturbance is present at any one time and the rate of reclamation. Approximately 2,602 acres would be disturbed for the LOP (i.e., approximately 105 years and until successful reclamation is achieved).

Erosion modeling was not conducted for Alternative B; the estimates shown in Table 4.8 are based on interpolation and the amount of surface disturbance. The greatest impact would likely still occur in the Long Draw and Bull Draw watersheds, which would have 11% surface area impacted, compared to 16% under the Proposed Action, and less than 1% under the No Action Alternative. Based on area of surface disturbance and interpolating from the two modeling scenarios (No Action and Proposed Alternatives), the amount of soil loss during the 5-year storm would be approximately 73,000 kilograms (representing a 163% increase over the No Action Alternative) and during the 150-year storm would be approximately 10.3 million kilograms (representing an 11% increase over the No Action alternative).

4.1.7.5 BLM Preferred Alternative

Impacts to soils under the Preferred Alternative would be similar to those described for all other alternatives and would be significant. While the total impacted acreage under the Preferred Alternative is 14,030–20,334 acres, not all of this acreage would be impacted at any given time. For soil loss estimates, the maximum disturbed acreage at any one time is the important measure. Implementation of the Preferred Alternative would result in a maximum 14,030 acres of additional surface disturbance, at any given time, above that of the No Action Alternative, subsequently resulting in an assumed increase in soil impacts. Impact potential would increase as development occurs (for approximately 13 years); therefore, all surface disturbance would not be present at any one time.

As with Alternative B, no erosion modeling was conducted for the Preferred Alternative as presently configured. Rather, the estimates presented in Table 4.8 are based on the amount of surface disturbance expected under the Preferred Alternative and interpolation from the four scenarios that were modeled (undisturbed condition, No Action, Proposed Action, and the DEIS Preferred Alternative). Using this approach, the amount of soil loss during the 5-year storm would be approximately 163,000 kilograms (representing a 486% increase over the No Action Alternative) and during the 150-year storm would be approximately 12.4 million kilograms (representing a 33% increase over the No Action Alternative).

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5).

4.1.7.6 Cumulative Impacts

The CIAA for soil resources is the 10 watersheds that drain the JIDPA, which encompass approximately 210,300 acres. Areas east of Big Sandy River, occurring within the Big Sandy River-Bull Draw watershed, are included in the CIAA; however, no project impacts (cumulative or otherwise) would occur in this area. Approximately 1.6% of the CIAA (3,355 acres) has been disturbed by well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residential areas (i.e., ranches) (see Table 3.11). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance (992 acres or 4.2% of the watershed), most of which is from existing natural gas development in the Jonah Field.

RFD (total surface disturbance) for the portion of the soil resources CIAA outside the JIDPA is estimated at 594 acres (see Table 4.6), primarily from gas-related development in the Pinedale Anticline Natural Gas Field. Approximately 38% (228 acres) of the RFD would occur in the Expanded Sand Draw-Alkali Creek watershed. RFD for the North Alkali Draw watershed is estimated at 168 acres, Southeast New Fork River is estimated at 126 acres, the Big Sandy River-Bull Draw is estimated at 54 acres, and Upper Eighteenmile Canyon is estimated at 18 acres.
Maximum cumulative disturbance for the No Action Alternative (i.e., the combined existing and RFD disturbance) would be 6,753 acres (3.2%) in the combined watersheds. The maximum cumulative disturbance for the Proposed Action, Alternative A, and the BLM Preferred Alternative (i.e., the combined existing, proposed, and RFD disturbance) could be on the order of 22,900 acres (10.9%) in the combined watersheds (see Table 4.6). Under Alternative B, maximum cumulative disturbance would be increased from the No Action Alternative to 9,975 acres, 4.8% of the combined watersheds.

Maximum cumulative disturbance would be greatest in the combined watersheds that drain into the Green River, and disturbance would be greatest in the Expanded Sand Draw-Alkali Creek watershed (see Tables 4.6 and 4.7). Based on erosion modeling, the greatest soil loss would be experienced in watersheds contributing to the Big Sandy River (Long Draw and Bull Draw). Gas development would continue to be the primary component of this disturbance. Maximum cumulative disturbance as a result of the No Action Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 2,355 acres (10.3% of the watershed). Maximum cumulative disturbance as a result of the Proposed Action and Alternative A in the Expanded Sand Draw-Alkali Creek watershed is estimated at 9,612 acres (41.9% of the watershed). Maximum cumulative disturbance in the Expanded Sand Draw-Alkali Creek watershed is estimated to be 3,805 acres (16.6%) under Alternative B. Maximum cumulative disturbance as a result of the Preferred Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 6,775–9,612 acres (29.5–41.9% of the watershed). The Long Draw watershed, which drains 16% of the JIDPA, would experience the next greatest amount of cumulative disturbance. The closed basin watersheds—Jonah Gulch and 140401040603—would likely only experience a small percentage of cumulative disturbance to soils.

4.1.7.7 Unavoidable Adverse Impacts

Productivity of some disturbed soils would be reduced due to removal of vegetation, increased soil exposure, mixing of soil horizons, and increased susceptibility to wind and water erosion. Some increased soil loss through erosion would be unavoidable under all of the alternatives.

4.1.8 Surface Water and Groundwater

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with water resources:

- to maintain, improve, and/or protect surface water and groundwater quality;
- to maintain or improve channel stability and overall watershed conditions;
- to protect, maintain, or improve wetlands, floodplains, riparian areas, and other water resources;
- to conserve water and relate water resources and development to desired land use;
- to support and encourage water quality monitoring programs;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds;
- to encourage strategies that utilize Wyoming's appropriated share of Colorado River waters for beneficial uses;
- to consider potential effects on surface water and groundwater quality/resources when land uses are planned or proposed, particularly near watercourses and lakes;
- to ensure land uses and developments do not accelerate long-term groundwater depletion; and
- to comply with water quality standards (e.g., salinity) set forth by the Colorado River Basin Salinity Control Act.

Impacts to surface water or groundwater would be significant 1) if water quality declined (e.g., from sedimentation, accidental spills, or cross-aquifer mixing) such that existing WDEQ water quality classes (WDEQ 1990) would be downgraded; 2) if water quantities were depleted such that the water rights of groundwater or downstream users would be violated; 3) if project-related erosion and runoff into intermittent drainages and subsequently into perennial waters altered the physical characteristics of these waters; 4) if project activities resulted in a violation of RMP objectives within or downstream of the JIDPA; and/or 5) if project activities resulted in a violation of Colorado river Water Quality standards for salinity (723 mg/L salinity below Hoover Dam [Colorado River Basin Salinity Control Forum 2002]).

There would be no use of or depletion of surface waters associated with the project. No impacts to and/or from flooding are anticipated because areas adjacent to drainages would be avoided.

The erosion modeling conducted by HydroGeo (2005) indicates that even under the 150-year storm event, runoff originating on the JIDPA infiltrates or evaporates before reaching either the Green River or Big Sandy River (see Appendix E). However, because sediment lost from the watershed is redeposited downstream, a succession of storm events will eventually transport a portion of this sediment to perennial surface waters. With successful reclamation (including interim reclamation occurring during the LOP [Appendix B]) and the construction of sediment retention/catchment areas where needed, only minor amounts of project-related runoff sediments are anticipated to reach perennial surface waters.

In addition to sediment load, water quality can be impacted by dissolved constituents imparted by the transported sediments. Concentrations of dissolved solids in water in contact with soils in the project area have been estimated at 300 to 1,300 milligrams per liter (mg/L). However, this assumes that the contact time with the soils is long enough for waters to reach equilibrium with the salinity of the soil. In reality, the relatively rapid dissipation of storm flows indicated by the erosion modeling may not provide this opportunity. Because no runoff from the JIDPA reaches perennial waters, even during the 150-year storm event, salinity impacts likely are not significant.

Potential impacts to local surface water and/or groundwater resulting from the project include increased turbidity, salinity, and sedimentation of surface waters due to runoff and erosion from disturbed areas; accidental spills of petroleum products or other pollutants; and cross-aquifer mixing. No direct discharge of unsuitable quality produced water or pipeline test water is planned. Impacts to surface water from development generally would result from increased runoff from disturbed areas, and it is assumed that with increased surface disturbance acreage, there would be a corresponding decrease in water quality (increased sediment loads in runoff waters) and increased runoff rates. Rates of wind and water erosion would increase above natural rates until successful reclamation of disturbed areas is achieved. Short-term control of surface runoff would be dependent on the success of reclamation and revegetation efforts described in site-specific reclamation plans, Surface Use Plans, or Plans of Development prepared for each APD and/or ROW application, and SWPPPs.

Concentrating development actions at larger well pads would have increased site-specific effects on overland flow patterns, groundwater infiltration (reduced on compacted areas), and runoff volumes (increased rates and potential erosion and sedimentation). Additionally, if surface disturbance is concentrated in any one watershed, increased potential erosion and runoff-related effects may occur, possibly requiring the need for special treatments to be specified in APD approvals. Estimates of potential total and LOP disturbance associated with the Proposed Action and each of the alternatives within each project-affected watershed are presented in Tables 4.6 and 4.7 and discussed under each alternative. Development activities in the JIDPA such as roads and well pads could affect natural overland flow patterns and groundwater infiltration. Compacted areas (e.g., roads and well pads) could reduce groundwater infiltration and potentially could increase the erosive potential of runoff events by creating a shorter period of runoff and an increased volume of runoff water and contained sediments. While increased sedimentation and salinity volumes are unknown, potential impacts could occur if increases result in the loss of channel stability and a decrease in overall watershed condition. While proper design, construction, and maintenance of proposed facilities would reduce erosion potential, these actions may not entirely compensate for anticipated increased flows.

As noted in Section 3.1.6.2, groundwater at depths less than approximately 2,300 feet below ground surface is relatively fresh, and the aquifer is extensive. Proposed groundwater consumption of fresh water would result in the temporary partial depletion of this aquifer. An estimated maximum of 4.9 acre-ft of new groundwater would be required to drill and complete each well (Table 4.9), and this water would be obtained from approximately 41 (25 existing, 16 new) water wells drilled to the top 600 feet of the aquifer.

Water wells pumping water out of an aquifer create a cone of depression, where groundwater levels are lowered near the pumping wells. The groundwater model MODFLOW was used to simulate the cone of depression created by pumping of all proposed groundwater from the existing 25 water wells and to determine the approximate time to full recovery of the aquifer after pumping stops (full recovery is defined as the point in time when drawdown is 1.6 feet or less) (HydroGeo, Inc. 2004). Two development rates were modeled: development of 75 wells per year over 41.3 years and 250 wells per year over 12.4 years (see Table 4.9).

Table 4.9. Summary of Groundwater Pumping Scenarios (3,100 total wells), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

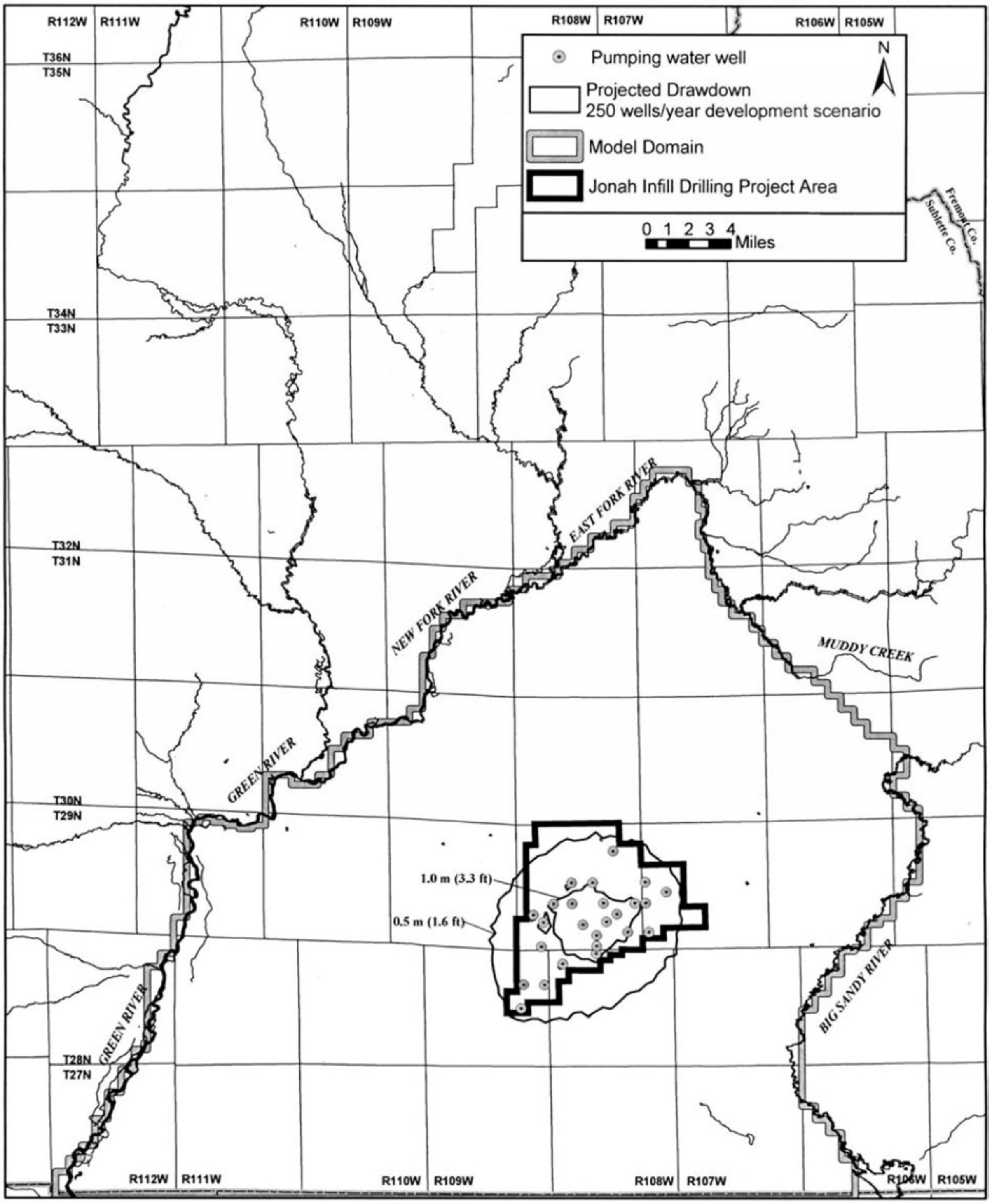
Gas Wells/ Year	Water Need per Gas Well (acre-ft/yr)	Water Need for All Gas Wells (acre-ft/yr)	Length of Drilling Program (years)	Number of Pumping Water Wells	Water per Pumping Well (acre-ft/yr)	Water per Pumping Well (gpm)
75	4.9	367.5	41.3	25	14.7	9.1
250	4.9	1,225.0	12.4	25	49.0	30.4

Groundwater modeling results (Map 4.1) showed that the cone of depression would extend only about 1.0 mile beyond the boundary of the JIDPA, even for the most rapid rate of maximum development (250 wells per year over 12.4 years) and that drawdown would be no greater than about 10 feet in the JIDPA (HydroGeo, Inc. 2004). The results also showed that the aquifer would fully recover within 0.5 to 6 years following the cessation of pumping (Table 4.10). Outside the JIDPA, no notable impacts to surface water or groundwater would occur due to pumping. Groundwater quality would not be impacted as a result of freshwater pumping because the freshwater aquifers from which proposed waters would be obtained are isolated from deeper, poorer quality waters. None of the alternatives would result in significant aquifer drawdown, and this impact is not discussed further, except to note that rate of development would impact rate of aquifer recovery.

Table 4.10. Groundwater Recovery Time (3,100 Wells), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

No. Gas Wells/Year	Years of Pumping	Years to Full Recovery after Pumping Ends	Total Years to Full Recovery
75	41.3	0.5	41.8
250	12.4	6.0	18.4

Potential for contamination of the freshwater aquifer is low because the well drilling and casing practices used by the Operators and required by BLM and the WOGCC limit the potential for movement of any materials outside the well casing and across aquifers. Accidental contamination is possible but would be mitigated through a groundwater cleanup program, the scope of which would be determined by WDEQ should a reportable incident occur (see Appendix B).



Map 4.1. Modeled Cone of Depression for Development of 250 Wells per Year over 12.4 Years (3,100 Total Wells), Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Gas wells are expected to produce 0.5–10.0 barrels of water per day, which would be disposed of as described in Appendix B. The brackish water aquifer(s) that is the source of the produced water is thought to be isolated from the freshwater aquifer described above; thus, water production and disposal is not likely to impact the quantity or quality of fresh groundwater. Furthermore, because it apparently is isolated, production and disposal or reuse of this water for the project is not likely to impact surface water resources within or outside of the JIDPA.

Hydrostatic pipeline testing water that does not meet applicable state and federal surface water or groundwater standards would not be released on the ground surface. This water may require treatment in a lined treatment pond prior to discharge or may be transported away from well locations to lined evaporation ponds or injector wells for disposal. All disposal and/or reuse of produced and test water would be in accordance with WDEQ rules and regulations and BLM *Onshore Oil and Gas Order No. 7*. Considerable volumes of produced water could be purified and reused to the extent technically and economically feasible for project operations (see Appendix B).

Impacts to surface water resources could be significant under any project alternative, except the No Action Alternative. Under all alternatives, Operators would be required to implement management requirements and mitigation measures (see Appendices A and C); therefore, impacts to surface water also would be relative to the effectiveness of these additional requirements.

No significant impacts to groundwater resources are anticipated under any alternative.

4.1.8.1 No Action Alternative

Under the No Action Alternative, no additional activities would occur that would potentially affect water resources other than those previously approved for the area (BLM 1998b, 2000b)—2,811 acres of short-term and 1,409 acres of LOP disturbance (see Table 2.2), or 9.2% and 4.6% of the JIDPA, respectively. Total disturbance would equal 4,209 acres. Some ephemeral drainages would remain prone to flooding after storm events, and their channels would continue to be subject to erosion at existing rates. The duration of impacts to surface water would be approximately 63 years (see Table 2.1) and until areas are adequately reclaimed. Further groundwater pumping would not be conducted, and aquifers would begin recharging immediately. Prior decisions found that the existing project would be unlikely to significantly impact surface water or groundwater resources (BLM 1998b, 2000b).

4.1.8.2 The Proposed Action

Compared to the No Action Alternative, the Proposed Action would result in an estimated additional 16,200 acres of new disturbance, for a total of 20,126 acres in the JIDPA (66.0% of the JIDPA) and an additional 283 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under the Proposed Action would be 20,409 acres (see Table 4.6). Approximately 70.5% (14,388 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would increase as development occurs (for approximately 13 years). The magnitude of surface disturbance would depend on the amount of disturbance present at any one time and the rate of reclamation. The remaining 6,043 acres would be disturbed for the LOP (approximately 76 years and until successful reclamation is achieved); thus, surface water impacts would last approximately 13 years longer than under the No Action Alternative. As a result of this surface disturbance, impacts to surface water could be significant.

Estimates of potential total and LOP disturbance acreages associated with the Proposed Action and each of the alternatives within each project-affected watershed are presented in Tables 4.6 and 4.7. Based on modeled sediment erosion, the Long Draw and Bull Draw watersheds would suffer the greatest impact to surface water resources due to sediment transport and increased salinity. Under the Proposed Action, LOP impacts to these watersheds increases from 1,136 acres under the No Action Alternative to 5,713 acres, or from 13% to 66% of the area of these two watersheds within the JIDPA. However, modeling indicates that runoff from the JIDPA does not reach the Big Sandy River, even during the 150-year event.

Under the Proposed Action, types of impacts to groundwater would be similar to those described for the No Action Alternative and, with effective mitigation, it is anticipated that the potential for adverse impacts also would be similar. However, more fresh groundwater would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Under the Proposed Action, the duration of groundwater impacts would be approximately 13 years longer than under the No Action Alternative (i.e., the development phase [see Table 2.1]) plus 6 years required to recharge the aquifer (see Table 4.10).

4.1.8.3 Alternative A

Implementation of Alternative A is anticipated to result in the same types and volumes of water resource impacts as described for the Proposed Action (see Section 4.1.8.2 and Tables 4.6 and 4.7). However, because selected Operator-committed and BLM-required practices (e.g., avoidance of drainage buffers) would not be implemented, significant impacts are more likely to occur under this alternative. Because development of natural gas resources in these areas would not require the use of directional drilling, impacts to surface water resources, particularly sedimentation into the Big Sandy watersheds, likely would be greater than under the Proposed Action. As with the Proposed Action, areas would not all be disturbed at the same time; rather, disturbance would accumulate as development occurs. Impacts to surface water occur throughout the LOP, would last approximately 13 years longer than under the No Action Alternative, and could be significant.

Implementation of Alternative A is anticipated to result in the same types of impacts to groundwater as described for the Proposed Action.

4.1.8.4 Alternative B

Implementation of Alternative B would result in an estimated additional 3,222 acres of new disturbance above that of the No Action Alternative, for a total of 7,223 acres in the JIDPA (23.7% of the JIDPA) and 208 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under Alternative B would be 7,431 acres (see Table 4.6). Approximately 65.2% (4,848 acres) of this disturbance would be reclaimed as soon as practical after disturbance. Disturbance would not occur all at once but would accumulate as development occurs (approximately 42 years). The remaining 2,602 acres would be disturbed for the LOP (approximately 105 years and until successful reclamation is achieved); thus, surface water impacts would last approximately 42 years longer than under the No Action Alternative, depending on the rate of development. These impacts could be significant.

Based on modeled sediment erosion, the Long Draw and Bull Draw watersheds would have the greatest impact to surface water resources due to sediment transport and increased salinity. Under Alternative B, LOP impacts to these watersheds increases from 1,136 acres under the No Action Alternative to 2,050 acres, or from 13% to 24% of the area of these two watersheds within the

JIDPA. However, modeling indicates that runoff from the JIDPA does not reach the Big Sandy River, even during the 150-year event.

Implementation of Alternative B would result in the same types of impacts to groundwater as the No Action Alternative; however, more fresh groundwater would be consumed and more poor-quality water would be produced because more gas wells would be drilled. Because the rate of development may vary under Alternative B, the duration of groundwater impacts would range from approximately 13 to 42 years longer than the No Action Alternative (i.e., the development period) plus 1 to 6 years required to recharge the aquifer.

4.1.8.5 BLM Preferred Alternative

Implementation of the Preferred Alternative would result in an estimated additional 9,821–16,125 acres of new disturbance above that of the No Action Alternative, for a total of 13,822–20,126 acres in the JIDPA (45.3–66.0% of the JIDPA) and 208 acres for ancillary facilities that may be constructed outside the JIDPA. Total disturbance under the Preferred Alternative would be 14,030–20,334 acres (see Table 4.6). If the Operators maximize ongoing reclamation as described in Section 2.4.5, total acres affected would be comparable to that of the Proposed Action (20,334 acres vs. 20,409 acres). However, at any one time, only 14,030 acres would be disturbed under the Preferred Alternative, as successful reclamation would be required for additional disturbance. Disturbance would not occur all at once but would accumulate as development occurs (for approximately 13 years); thus, surface water impacts would last approximately 13 years longer than under the No Action Alternative.

Impacts to surface water resources under the Preferred Alternative would be similar to those described under the Proposed Action and the other alternatives and could be significant; however, impacts are expected to be proportional to the amount of disturbance present at any one time. Potential impacts to surface water from the Preferred Alternative (14,030 acres of disturbance at any one time) would likely be somewhat less than the Proposed Action and Alternative A, where the disturbance at one time would not be regulated. Additionally, it is anticipated that potential impacts to surface water under the Preferred Alternative would be greater than impacts to surface water resources as a result of Alternative B, where maximum total disturbance is estimated at 7,431 acres. Impacts are anticipated to be greatest in areas developed with the highest well pad densities.

Based on modeled sediment erosion, the Long Draw and Bull Draw watersheds would have the greatest impact to surface water resources due to sediment transport and increased salinity. Because of concurrent reclamation, the amount of disturbance at any one time within these watersheds is not known. However, modeling indicates that runoff from the JIDPA does not reach the Big Sandy River, even during the 150-year event.

Implementation of the Preferred Alternative would result in the same types of impacts to groundwater as the No Action Alternative. Larger volumes of fresh water would be needed to drill directional wells and more wells would be drilled, so groundwater consumption would be greater than for the No Action Alternative and comparable to the Proposed Action and Alternatives A and B. The duration of groundwater impacts would be approximately 13 years (i.e., the development period) longer than the No Action Alternative plus 6 years required to recharge the aquifer.

Under the Preferred Alternative additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5).

4.1.8.6 Cumulative Impacts

The CIAA for surface water resources is the 10 watersheds that drain the JIDPA, which encompass approximately 210,300 acres. The overall stability of these watersheds is not anticipated to be significantly affected within the CIAA under any project alternative. Areas east of Big Sandy River, occurring within the Bull Draw watershed, are included in the CIAA; however, no project impacts would occur in this area. This is the same CIAA for soils and vegetation. Approximately 1.6% of the CIAA (3,355 acres) has been disturbed by well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residential areas (i.e., ranches) (see Table 3.11). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance (992 acres or 4.2% of the watershed), most of which is from existing natural gas development in the Jonah Field.

RFD for the portion of the surface water CIAA outside the JIDPA is estimated at 594 acres, primarily from gas-related development in the Pinedale Anticline Natural Gas Field (see Table 4.6). Approximately 38% (228 acres) of the RFD would occur in the Expanded Sand Draw-Alkali Creek watershed. RFD for the North Alkali Draw watershed is estimated at 168 acres; for the Southeast New Fork River-Blue Rim watershed it is estimated at 126 acres; for the Big Sandy River-Bull Draw watershed it is estimated at 54 acres; and for the Upper Eighteenmile Canyon watershed it is estimated at 18 acres.

Maximum cumulative disturbance for each alternative (i.e., the combined existing, alternative-specific, and RFD disturbance) is shown in Table 4.6. Cumulative impacts would be as described for all alternatives, but increased in volume and duration.

Maximum cumulative disturbance would be greatest in the combined watersheds that drain into the Green River, and disturbance would be greatest in the Expanded Sand Draw-Alkali Creek watershed (see Tables 4.6 and 4.7). Gas development would continue to be the primary component of the disturbance. Maximum cumulative disturbance as a result of the No Action Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 2,355 acres (10.3% of the watershed). Maximum cumulative disturbance as a result of the Proposed Action and Alternative A in the Expanded Sand Draw-Alkali Creek watershed is estimated at 9,612 acres (41.9% of the watershed). Maximum cumulative disturbance in the Expanded Sand Draw-Alkali Creek watershed is estimated to be 3,805 acres (16.6%) under Alternative B. Maximum cumulative disturbance as a result of the Preferred Alternative in the Expanded Sand Draw-Alkali Creek watershed is estimated at 6,775–9,612 acres (29–41.9% of the watershed). The Long Draw watershed, which drains 16.5% of the JIDPA, would experience the next greatest amount of cumulative disturbance. The closed basin watersheds—Jonah Gulch and 140401040603—would likely only experience a small percentage of cumulative disturbance to surface waters.

The CIAA for groundwater includes the JIDPA and adjacent drawdown areas (see Map 4.1). Because no actions other than those proposed for this project are anticipated in the area, cumulative impacts to groundwater would be of the same type and extent as those described for the No Action and action alternatives.

4.1.8.7 Unavoidable Adverse Impacts

Based on the hydrologic modeling, it is anticipated there will be minimal unavoidable adverse impacts to surface water and soils resulting from cumulative events for the LOP. This expectation results from the increase in surface disturbance in watersheds in the JIDPA. These impacts have the potential to reduce water quality in ephemeral drainages during runoff events. On a watershed scale, little impact would be expected on downstream perennial waters.

Project development would require a maximum of approximately 15,200 acre-ft of fresh water from shallow groundwater aquifers.

4.1.9 Noise and Odor

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) do not specify any management goals/objectives specifically associated with noise and odor. However, the BLM's general goal of preserving and maintaining the quality of the environment while coordinating multiple use objectives remains applicable for noise and odor.

Impacts from noise and odor would be considered significant if they resulted in displacement of area residents, the loss of important wildlife features (e.g., greater sage-grouse leks, raptor nests, pronghorn migration corridors), and/or if BLM's goals of preserving and maintaining the quality of the environment could not be met.

Additional noise sources above and beyond current levels (i.e., the No Action Alternative) would include scraping, grading, and construction of new well pads; drilling, completion, and operation of new wells; Burma Road upgrade activities for some alternatives and associated increases in traffic; construction, maintenance, and traffic associated with new resource roads, gathering pipelines, and collector/resource roads; construction/upgrade of ancillary facilities (i.e., water disposal, storage, and compressor station facilities); and exploration activities. Additional odor sources would be associated primarily with wells and exhaust from increased vehicular traffic.

Drilling and flaring operations would produce temporary noise levels of up to 115 dBA at the source, with noise levels of 55 dBA at 3,500 feet from the source (see Section 3.1.7). These activities are expected to be the loudest proposed noise-producing operations and would continue 24 hours/day at well sites during development periods (see Appendix B). Increased noise levels associated with construction equipment (e.g., scrapers, dozers, trucks, graders, loaders) are expected to be between 70 and 90 dBA at about 50 feet from the source and would attenuate at a rate of approximately 6 dBA with each doubling of distance from the source (Table 4.11). Noise levels associated with production at each well pad would be minimal because no pumping is required. Noise levels associated with compressor stations (between 64 and 86 dBA at compressor stations, between 58 and 75 dBA at approximately 1.0 mile away) would continue at current levels for the LOP. Further noise level data are provided in Section 3.1.7, Figure 3.13, and Table 3.16.

Table 4.11. Estimated Noise Attenuation with Distance from Construction Equipment, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Distance from Source (feet)	DBA (Example Noise Source)	
50	70 (busy traffic)	90 (endangers hearing)
100	64 (conversation)	84 (noisy factory)
200	58 (conversation)	78 (noisy factory)
400	52 (quite)	72 (busy traffic)
800	46 (library)	66 (busy traffic, conversation)

Project noise may be heard 20 or more miles from the area, and although this noise would be barely audible at such distance, it could affect resident and recreating visitor perceptions of solitude. Some area residents have indicated that project noise (especially at night) is pervasive and disruptive and does affect their quality of life.

Under most weather conditions, it is anticipated that project odors would disperse rapidly and would not affect area users greater than 1.0 mile from sources; however, during temperature inversions and at other windless times, odors could be detected at distances greater than 1.0 mile from the JIDPA. This impact would be considered significant and could occur under all project alternatives.

It is likely that noise already has contributed to the apparent decrease in wildlife use on and adjacent to the JIDPA (see Section 4.2.2), with observed decreases in raptor nesting activity and productivity, male greater sage-grouse lek attendance and sage-grouse nesting within the JIDPA having been reported over the past several years (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). Data also suggest that noise may contribute to disturbance and/or departure of greater sage-grouse from area leks (TRC Mariah 2001d, 2003a).

Although project-related noise and odor are not anticipated to pose a human health hazard to persons in the area, they likely would be noticeable to recreationists and other visitors on and in the vicinity of the JIDPA (see Section 4.5.3) and might cause decreased use or diminished enjoyment of the area. Significant impacts from noise and odor are anticipated within the JIDPA and vicinity under all alternatives, although no additional significant impacts would occur under the No Action Alternative.

4.1.9.1 No Action Alternative

Under the No Action Alternative, impacts due to noise and odor would be as identified and approved for existing Jonah Field developments (see Section 3.1.7). Prior decisions found existing project noise and odor impacts to be less than significant (BLM 1998b, 2000b). However, monitoring data collected since those decisions were made indicate that noise associated with existing oil and gas development activities may be contributing to documented decreases in wildlife use on and adjacent to the JIDPA (i.e., may be significant) (TRC Mariah 1999, 2001a, 2001b, 2001d, 2002, 2003a, 2004a). No additional significant impacts relating to noise and odor are expected under the No Action Alternative.

Once all approved wells are drilled and developed, noise levels would be reduced by limiting sources to those needed for production (primarily traffic), compressor stations, and reclamation (farm equipment), and would continue for an estimated 63 years and until all reclamation activities are completed.

4.1.9.2 The Proposed Action

Under the Proposed Action, the nature of impacts due to noise and odor would be similar to those of the No Action Alternative, but levels would be substantially increased as a result of the new wells, well pads, and other proposed project facilities. Significant impacts from noise and odor are anticipated within the JIDPA and vicinity.

Increased noise levels associated with construction of new well pads; drilling and completion of new wells; upgrade and/or construction of roads; and other project construction activities would be short term at any given location but would continue throughout the field development period—approximately 13 years. Noise levels from field traffic and well maintenance actions (which might include some flaring) would occur for an estimated 76 years and until all reclamation activities are completed, or approximately 13 years longer than the No Action Alternative.

Odors present periodically at well and ancillary facility locations and along roadways could offend area users in the vicinity of emission sources. However, odors would be dispersed by wind and are not anticipated to adversely affect the majority of area users.

4.1.9.3 Alternative A

Under Alternative A, noise and odor levels would be similar to those of the Proposed Action. However, potential noise-related impacts to wildlife would be amplified in areas that would have been avoided under the Proposed Action (i.e., greater sage-grouse lek and raptor nest buffers [see Section 4.2.2]), increasing the potential for significant impacts. Odor impacts would be the same as described for the Proposed Action. Noise and odor impacts would occur for an estimated 76 years and until all reclamation activities are completed, or approximately 13 years longer than under the No Action Alternative. Significant impacts from noise and odor are anticipated within the JIDPA and vicinity.

4.1.9.4 Alternative B

Impacts due to noise and odor under Alternative B would be similar to those described for the Proposed Action except that elevated noise levels during development would be concentrated at the existing 497 wells pads and noise associated with construction of new well pads would not occur. Use of directional drilling would increase the site-specific (per well pad) duration of the noise impacts due to the additional time necessary to drill directional wells and the increased number of wells drilled per pad. Duration of field-wide impacts would be approximately 105 years plus the time required to complete reclamation activities, or approximately 42 years longer than under the No Action Alternative. Significant impacts from noise and odor are anticipated within the JIDPA and vicinity.

4.1.9.5 BLM Preferred Alternative

Impacts due to noise and odor under the Preferred Alternative would be substantially higher than those described under the No Action Alternative but lower than described for other action alternatives because this alternative requires implementation of additional mitigation and monitoring measures/management requirements (see Section 2.4.5). Implementation of these measures would decrease noise and odor impacts from those described for other action alternatives but impacts associated with noise would still be considered significant within the JIDPA.

Duration of field-wide noise and odor impacts would be approximately 76 years plus the time required to complete reclamation work, or approximately 13 years longer than under the No Action Alternative.

4.1.9.6 Cumulative Impacts

The CIAA for noise includes the JIDPA plus a 20-mile buffer, whereas the CIAA for odor is the JIDPA and a 2.0-mile buffer. Odors likely would not be detected more than 1.0 mile from the JIDPA and, in most cases, would be confined to the JIDPA because of dispersion. Noise impacts from the project in combination with other existing and proposed noises (most notably those from development in the Pinedale Anticline area) may be heard throughout the CIAA for the LOP. These noise levels could affect the use of some habitat features proximal to the JIDPA by wildlife (see Section 4.2.2) and may affect some recreationists and other visitors through a reduction in the perceived quality of experience throughout the CIAA. In no instance is it anticipated that cumulative noise levels would pose a human health hazard. Significant cumulative impacts associated with noise and odor are possible and would vary across alternatives depending upon the pace and extent of development. Cumulative impacts are anticipated to be greatest under the Proposed Action and Alternative A and least under the No Action Alternative.

4.1.9.7 Unavoidable Adverse Impacts

All of the action alternatives would result in some additional noise and odors within the JIDPA and in surrounding areas.

4.2 BIOLOGICAL RESOURCES

4.2.1 Vegetation

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (Wyoming State Land Use Commission 1979) and Sublette County (Sublette County Board of Commissioners and Sublette County Planning Commission 2003) identify the following management goals/objectives associated with vegetation:

- to maintain or enhance vegetation community health, composition, and diversity to meet watershed, wild horse, and wildlife resource management objectives;
- to provide for plant diversity (desired plant communities) to meet livestock management, watershed, wild horse, and wildlife objectives; and
- to reduce the number and spread of invasive species.

Impacts to plant communities (including wetlands) are considered significant if there is a long-term reduction in vegetation productivity, a permanent change in species composition, an increase in invasive non-native species (including noxious weeds), a net loss of wetlands, or a vegetation loss that results in a violation of BLM RMP or other land use plan objectives within or outside the JIDPA. Impacts to vegetation and wetland resources are assumed to be proportional to the amount of new surface disturbance for all alternatives (i.e., increased surface disturbance would result in a corresponding increase to vegetation impacts).

Impacts to wetlands, waters of the U.S. (WUS), and riparian areas would be significant if there were a violation of Section 404 of the Clean Water Act or EOs 11988 or 11990 and/or if a BLM RMP or other land use planning objectives could not be achieved. Because these areas would generally be avoided, there are no perennial streams on the JIDPA, and the project would be developed in compliance with the Clean Water Act, no significant impacts to wetlands, WUS, or riparian areas are anticipated under any alternative.

At the end of the LOP, most, if not all, disturbed areas including roads would be reclaimed and revegetated; however, BLM system roads (e.g., Burma and Luman Roads) would likely remain in an upgraded status under all action alternatives, with the exception that the Burma Road would not be improved under Alternative B and the BLM Preferred Alternative.

All vegetation types that potentially could be disturbed by project-related development are common throughout the JIDPA and on surrounding lands. No uncommon or unique vegetation types would be impacted by the project. The estimated disturbance volumes to each of the vegetation types in the JIDPA are provided in Table 4.12.

Table 4.12. Vegetation Type Disturbance Across Alternatives, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Alternative and Disturbance Type	Dense Sagebrush	Moderate Density Sagebrush	Scattered/ No Sagebrush	Basin Big Sagebrush	Unknown Type (Unmapped Area)	Total (Acres of New Disturbance)
No Action						
Existing	3,671	375	112	7	44	4,209
LOP	1,229	126	37	2	15	1,409
Proposed Action and Alternative A						
New beyond No Action	14,129	1,445	431	25	170	16,200
LOP beyond No Action	4,039	413	123	7	49	4,631
Alternative B						
New beyond No Action	2,876	294	88	4	35	3,222
LOP beyond No Action	1,058	108	32	2	13	1,193
Preferred Alternative						
New beyond No Action	8,564–14,061	874–1,435	265–435	20–32	98–161	9,821–16,125
LOP beyond No Action	2,492–4,021	254–410	77–124	6–9	28–46	2,858–4,611
Total Acreage in JIDPA	**26,601**	**2,721**	**811**	**47**	**320**	**30,500**

Impacts associated with the removal of vegetation include loss of wildlife habitat, a reduction in vegetation diversity, potential for increased soil erosion, potential invasion of undesirable plant species (non-native and/or noxious), and loss of livestock forage. Because it would take many years for reclaimed areas to develop the structure and function of self-sustaining vegetation communities (i.e., sagebrush), impacts would persist for an undetermined number of years following reclamation. Reclaimed areas would produce less forage for several years until revegetation is considered successful, at which time grasses and possibly forbs would likely become more dominant than under existing conditions, providing increased forage for some wildlife and livestock (see Section 4.5.2). Shrubs may take 30–100 years or longer to reach predisturbance productivity levels and wildlife habitat complexity (Braun 1998, Slater 2003) (see also Section 4.2.2).

The duration of impacts to vegetation communities would depend essentially on two factors: 1) the rate of development (i.e., 75 wells per year under Alternative B or 250 wells per year under the other action alternatives) and 2) the duration of time needed for reclaimed areas to reach predisturbance conditions.

The following analyses show that all the alternatives are generally compatible with BLM management goals/objectives; however, significant impacts to vegetation are also anticipated in the JIDPA through loss of habitat, forage, and soil protection, and increased potential for invasive, non-native species invasion under any alternative except the No Action Alternative. For the PFO and RSFO areas as a whole, these significant impacts would not affect BLM's capability to manage vegetation resources pursuant to RMP objectives field-wide. Under all alternatives, specific management requirements and mitigation measures would be implemented; therefore, impacts to vegetation would also be relative to the effectiveness of these additional measures.

4.2.1.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect vegetation resources other than those previously approved for the area—4,209 acres of existing disturbance of which 1,409 acres would be LOP disturbance, or 13.8% and 4.6% of the JIDPA, respectively. The duration of impacts would be approximately 63 years. According to prior evaluations, it is unlikely that the existing project would significantly impact vegetation resources (BLM 1998b, 2000b) (see also Section 3.2.1).

4.2.1.2 Proposed Action

The Proposed Action would result in an estimated increase of 16,200 acres of new surface disturbance. Therefore, total disturbance under the Proposed Action, including existing disturbance, would be 20,409 acres (see Table 2.3). Of these 20,409 acres, 14,388 acres (70.5%) would be reclaimed and revegetated as soon as possible after disturbance. Not all disturbance would occur at one time, but rather would continue over an approximately 13-year period as development proceeds. The magnitude of surface disturbance at any one time would depend on both the amount of disturbed land present and the rate of ongoing reclamation. Approximately 6,043 acres of vegetation would be removed for the LOP (i.e., 76 years and until adequate reclamation is achieved). The surface disturbance anticipated under the Proposed Action would result in significant impacts to vegetation in the JIDPA.

The Expanded Sand Draw-Alkali Creek watershed could experience the greatest level of impacts to vegetation resources from project-related activities. Potential disturbance to this watershed from the Proposed Action could increase from the existing 4.2% of the watershed to 39.5% (see Table 4.7). Estimated LOP disturbance to the Expanded Sand Draw-Alkali Creek watershed from the Proposed Action could increase to 2,682 acres (11.7% of the watershed).

The removal of existing vegetation in the project area would, by disturbing soils and removing native plant cover, render habitats more susceptible to invasion by noxious weeds and other undesirable plant species.

Direct impacts to wetlands and WUS would be temporary, resulting from road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 feet of wetlands or open water or within 100 feet of ephemeral or intermittent channels. Indirect impacts to wetlands, WUS, and/or riparian areas could occur as a result of increased sediment deposition in these areas.

4.2.1.3 Alternative A

It is anticipated that implementation of Alternative A would result in the same types and volumes of vegetation impacts as the Proposed Action Alternative and would result in an increase in vegetation impacts from the No Action Alternative. However, under this Alternative, selected Operator-committed and BLM-required practices would not be implemented (i.e., avoidance of various buffers); therefore, impacts to vegetation, including wetlands, and WUS particularly in the Sand Draw area, would likely be greater than under the Proposed Action. The duration of vegetation impacts under Alternative A would be approximately 76 years. The surface disturbance anticipated under Alternative A would result in significant impacts to vegetation in the JIDPA.

4.2.1.4 Alternative B

Implementation of Alternative B would result in an increase of 3,222 acres of new surface disturbance from that of the No Action Alternative, thereby increasing potential impacts to vegetation. There would be 7,431 acres of total disturbance under Alternative B. Approximately 65% (4,848 acres) of this disturbance would be reclaimed and reseeded as soon as practical after disturbance. An estimated 2,602 acres of total LOP disturbance is anticipated for Alternative B. Compared with the No Action Alternative, LOP disturbance to vegetation from this Alternative would increase from 4.6% to 8.5 % of the JIDPA. Disturbance acreages and percentages within affected watersheds are provided in Tables 4.6 and 4.7, respectively. The duration of vegetation impacts under Alternative B is estimated at 105 years. The surface disturbance anticipated under Alternative B would result in significant impacts to vegetation in the JIDPA.

The removal of existing vegetation in the project area would, by disturbing soils and removing native plant cover, render habitats more susceptible to invasion by noxious weeds and other undesirable plant species.

Direct impacts to wetlands and WUS would be temporary, resulting from road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 feet of wetlands or open water or within 100 feet of ephemeral or intermittent channels. Indirect impacts to wetlands and WUS would occur as a result of increased sediment deposition in these areas.

4.2.1.5 BLM Preferred Alternative

Implementation of the Preferred Alternative would limit total surface disturbance in the Jonah Field at any one time to 14,030 acres (see Section 2.4.5). Contingent upon successful reclamation to BLM standards, Operators may receive credit on an acre-for-acre basis for additional surface disturbance up to 6,379 acres, or a maximum total disturbance through the LOP (new plus existing) of 20,334 acres. Total LOP disturbance (i.e., subsequent to interim reclamation) is expected to range from 4,267 to 6,020 acres, depending on how much acreage is successfully reclaimed, credited, and authorized for additional disturbance. Compared to the No Action Alternative, disturbance to vegetation would increase under this alternative to between 32.2% and

46.0% of the JIDPA, or to a total (new plus existing) of between 46.0% and 66.7% of the 30,500-acre project area. LOP disturbance to vegetation would increase to at least 13.9% and not more than 19.7% of the JIDPA. The surface disturbance anticipated under the Preferred Alternative would result in significant impacts to vegetation in the JIDPA.

The removal of existing vegetation in the project area would, by disturbing soils and removing native plant cover, render habitats more susceptible to invasion by noxious weeds and other undesirable plant species.

Direct impacts to wetlands and WUS would be temporary, resulting from road and pipeline crossings. Other proposed facilities (e.g., well pads, water disposal sites) would not be located within 500 feet of wetlands or open water or within 100 feet of ephemeral or intermittent channels. Indirect impacts to wetlands and WUS could occur as a result of increased sediment deposition in these areas.

Under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5).

4.2.1.6 Cumulative Impacts

The CIAA for vegetation, including wetlands and WUS, are the 10 watersheds that drain the JIDPA, which together encompass approximately 210,300 acres. Areas east of Big Sandy River occurring within the Big Sandy River-Bull Draw watershed are included in the CIAA; however, no project impacts would occur in this area. Approximately 1.6% of the CIAA (3,355 acres) has had native vegetation removed primarily as a result of well pads, agricultural lands (i.e., hay meadows), reservoirs, pipelines, roads, and residential areas (i.e., ranches). The Expanded Sand Draw-Alkali Creek watershed has the largest amount of existing disturbance, of which most is from existing natural gas development in the Jonah Natural Gas Field.

RFD and associated vegetation disturbance for the portion of the CIAA outside the JIDPA is estimated at 594 acres (see Table 4.6), and results primarily from gas-related development in the Pinedale Anticline Natural Gas Field. Approximately 38% (228 acres) of the RFD would occur in the Expanded Sand Draw-Alkali Creek Watershed. RFD is estimated at 168 acres for the North Alkali Draw Watershed; 126 acres for the Southeast New Fork River; 54 acres for the Big Sandy River-Bull Draw; and 18 acres for the Upper Eighteenmile Canyon.

Maximum cumulative disturbance for the No Action Alternative (i.e., the combined existing and RFD disturbance) would be 6,753 acres (3.2%) in the combined watersheds. The maximum cumulative disturbance for the Proposed Action, Alternative A, and the BLM Preferred Alternative (i.e., the combined existing, proposed, and RFD disturbance) could be on the order of 22,900 acres (10.9%) in the combined watersheds (see Table 4.6). Under Alternative B, maximum cumulative disturbance would be increased from the No Action Alternative to 9,975 acres, 4.8% of the combined watersheds.

Maximum cumulative disturbance would be greatest in the watersheds that drain into the Green River, and disturbance would be greatest in the Expanded Sand Draw-Alkali Creek Watershed (see Tables 4.6 and 4.7).

The Wyoming sagebrush vegetation type, the primary vegetation type in the JIDPA and CIAA (see Tables 3.17 and 3.18 and Maps 3.11 and 3.12), would experience the greatest amount of cumulative disturbance regardless of development alternative. Disturbance to Wyoming sagebrush vegetation communities would be greatest in the Expanded Sand Draw-Alkali Creek watershed, where gas development would continue to be the primary source of the disturbance. Maximum cumulative disturbance to vegetation in the Expanded Sand Draw-Alkali Creek Watershed is estimated at 2,355 acres (10.3% of the watershed) under the No Action Alternative, 9,612 acres (41.9% of the watershed) under the Proposed Action and Alternative A, 6,775 to 9,612 acres (29.5% to 41.9% of the watershed) under the Preferred Alternative, and 3,805 acres (16.6%) under Alternative B. The Long Draw Watershed, which drains 16% of the JIDPA, would experience the next greatest amount of cumulative disturbance to vegetation. The closed basin watersheds—Jonah Gulch and 140401040603—would likely only experience a small amount of cumulative disturbance to vegetation resources.

Within the CIAA, riparian and wetland habitats are primarily found along drainages and at ponds and reservoirs. Existing adverse impacts within these habitats include roads, livestock grazing, and recreational use. Wetlands, WUS, and riparian areas would be avoided where possible during implementation of this and other proposed projects in the area, so no significant direct impacts to these resources are anticipated. Indirect impacts to wetland and riparian areas would be limited to increased sediment deposition (see Section 4.1.8). A beneficial impact to riparian habitat would occur with planned improvements in grazing management. No permanent cumulative impacts are anticipated because all future development activities would comply with Section 404 of the Clean Water Act and EO 11990.

4.2.1.7 Unavoidable Adverse Impacts

The proposed project would temporarily remove from 13.8% (No Action, 4,209 acres) to 66.0% (Proposed Action and Alternative A, 20,409 acres) of the vegetation in the JIDPA and would thereby render habitats more susceptible to invasion by noxious weeds and invasive species.

Because wetlands, WUS, and riparian areas would generally be avoided and any disturbance of these areas would be promptly reclaimed, no long-term unavoidable adverse impacts to these resources are anticipated.

4.2.2 Wildlife and Fisheries

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (Wyoming State Land Use Commission 1979) and Sublette County (Sublette County Board of Commissioners and Sublette County Planning Commission 2003) identify the following management goals/objectives associated with wildlife and fisheries:

- to maintain, improve, or enhance the biological diversity of all plant and wildlife species while ensuring healthy ecosystems;

- to restore disturbed or altered habitat with the objective to attain desired native plant communities, while providing for wildlife needs and soil stability;

- to conserve and develop recreational resources for the benefit of present and future generations;

- to consider wildlife migration corridors, crucial winter ranges, and other important habitats when evaluating land use proposals;

- to support and maintain healthy wildlife populations as an appropriate and desired land use;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds; and
- to minimize conflicts between wildlife and domestic pets.

Impacts to wildlife and fisheries would be considered significant if any project action compromised the above management objectives, and significant impacts to most wildlife species on the JIDPA are anticipated under all project alternatives. Specific impacts that would be considered significant include, but would not be limited to, the physical loss or the abandonment of important wildlife features (e.g., greater sage-grouse leks, greater sage-grouse winter concentration areas, raptor nests and nesting and foraging territories, and pronghorn migration corridors), diminished wildlife diversity in the JIDPA, and degradation of crucial winter ranges and/or other important wildlife habitats. For the PFO and RSFO areas as a whole, impacts to wildlife on and adjacent to the JIDPA would not affect BLM's ability to manage these resources pursuant to RMP objectives.

In general, impacts to wildlife would result from 1) the direct loss of habitat due to removal of vegetation; 2) displacement of wildlife due to disturbance and/or noise from project-related activities including construction, drilling, traffic, and human presence (indirect habitat loss); 3) habitat fragmentation; 4) direct mortality due to construction activities and/or animal/vehicle collisions; 5) potential increased poaching and harassment as a result of increased access and human presence; 6) impediments to pronghorn antelope migration; 7) loss of habitat function (most notably for greater sage-grouse breeding, nesting, brood-rearing, and wintering); 8) loss of suitable raptor nesting areas and/or existing territories; and 9) a decrease in species diversity. No impacts to fisheries in the Big Sandy, New Fork, and Green Rivers are anticipated under any alternative due to the distance of the project from permanent surface waters, the absence of activities that contribute to surface water depletion, and the application of appropriate mitigation. Thus, impacts to fisheries are not discussed further in this section.

Exploration and development activities may cause severely fragmented habitats, and habitat treatments may not be an effective mitigation to offset the impacts of new and LOP disturbance or loss of habitat function. When sagebrush habitats are degraded, vegetation reestablishment may take many years. Wyoming big sagebrush habitats may require 30–100 years or more to recover to approximate predisturbance habitat characteristics (Braun 1998, Slater 2003). Therefore, habitat functionality, particularly for nesting species, on disturbed areas may not be achieved for more than 100 years. However, with successful reclamation, a mosaic of sagebrush successional stages, which is desirable for most sagebrush obligate species, would be available in the JIDPA within a shorter timeframe.

The Wilderness Society (2002) defines habitat fragmentation by quoting Noss and Csuti (1994); "Fragmentation of habitat can be defined as the decrease in the size of habitat patches and interior habitat and the increase in distance between patches." When large blocks of habitat are separated into small patches, the resulting fragmentation of the habitat may limit the ability of some animals to move, resulting in the use of inferior or unsuitable habitat. The Wilderness Society (2002) suggests that landscape analysis is a proven way to identify habitat fragmentation.

This EIS quantifies habitat fragmentation by using GIS technology to draw buffers of various widths around roads, pipeline ROWs, well pads, and other project-related disturbances.

The areas outside those buffers (i.e., those greater than a designated distance from project features and/or activities) are considered core areas. Core areas, by definition, are the habitat patches most removed from project disturbances and, in general, they are likely to have a higher comparative value to wildlife species in the JIDPA than non-core areas, all other factors being equal. By producing habitat fragmentation models of the JIDPA using various buffer distances (i.e., 0.5 mile, 0.25 mile, 0.125 mile, and 0.063 mile) from existing and/or possible project disturbance at various well densities (16, 32, and 64 wells per 640-acre section), an estimate of total acreage and numbers and average sizes of core areas within the JIDPA under a variety of development scenarios has been analyzed. The modeling results are provided in Tables 4.13 and 4.14 and Maps 4.2 through 4.5. Although it is suspected that some species in the area (e.g., greater sage-grouse and pronghorn antelope) are sensitive to varying degrees of fragmentation, insufficient scientific research has been conducted to determine what level of fragmentation is critical for individual populations or species.

Table 4.13. Percent of the JIDPA Contained within Core Areas for Existing Conditions and Selected Possible Development Scenarios, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

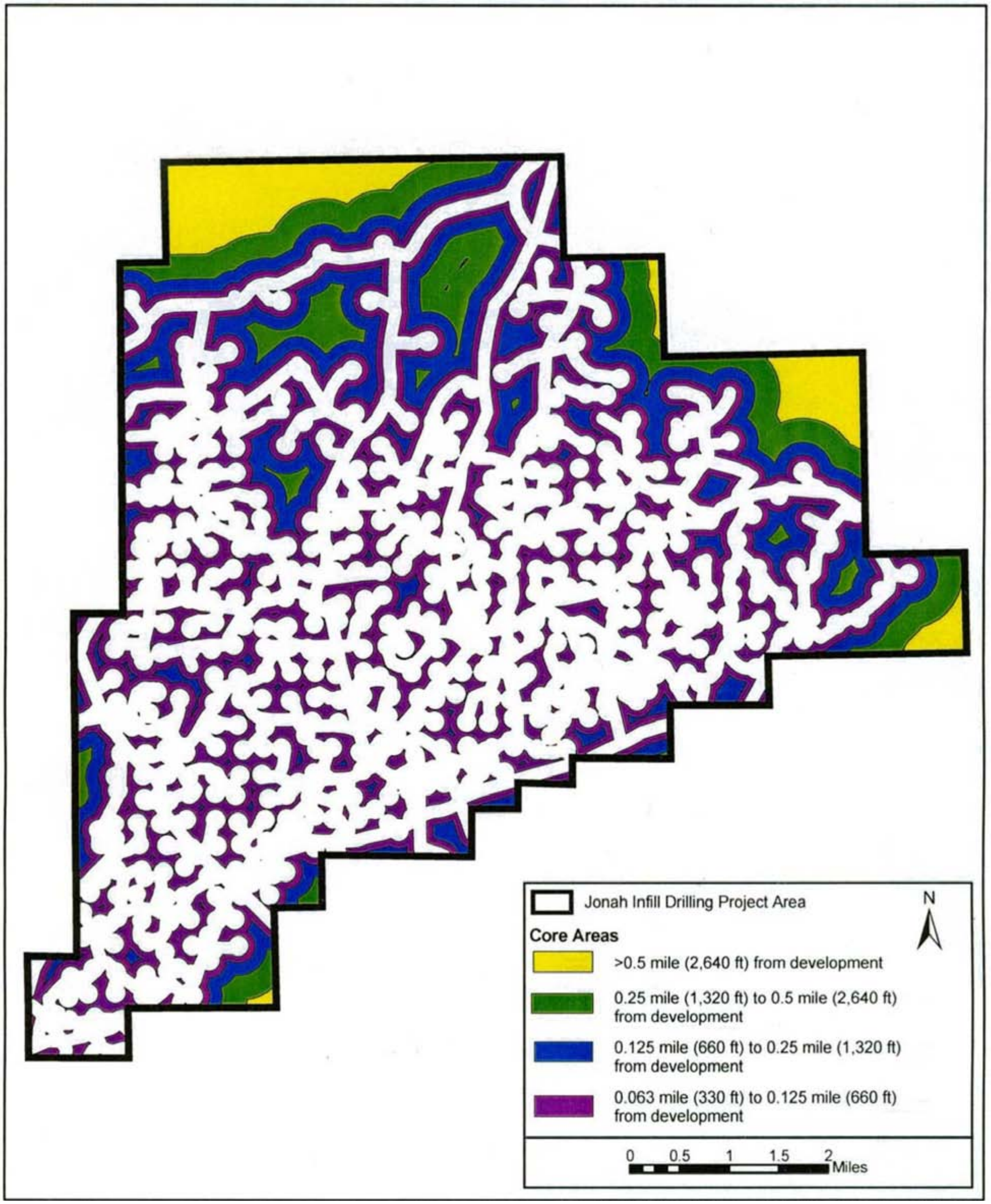
Disturbance Buffer	Percent of JIDPA in Core Areas (%)			
	Existing Conditions	16 Wells/Section	32 Wells/Section	64 Wells/Section
0.063 mile	45.3	28.6	10.10	2.10
0.125 mile	24.3	2.7	1.00	0.80
0.25 mile	12.6	0.2	0.04	0.02
0.5 mile	5.2	0	0	0

[1] Core areas are those areas within the JIDPA and outside the disturbance buffer (i.e., greater than a designated distance from Project-related disturbance).

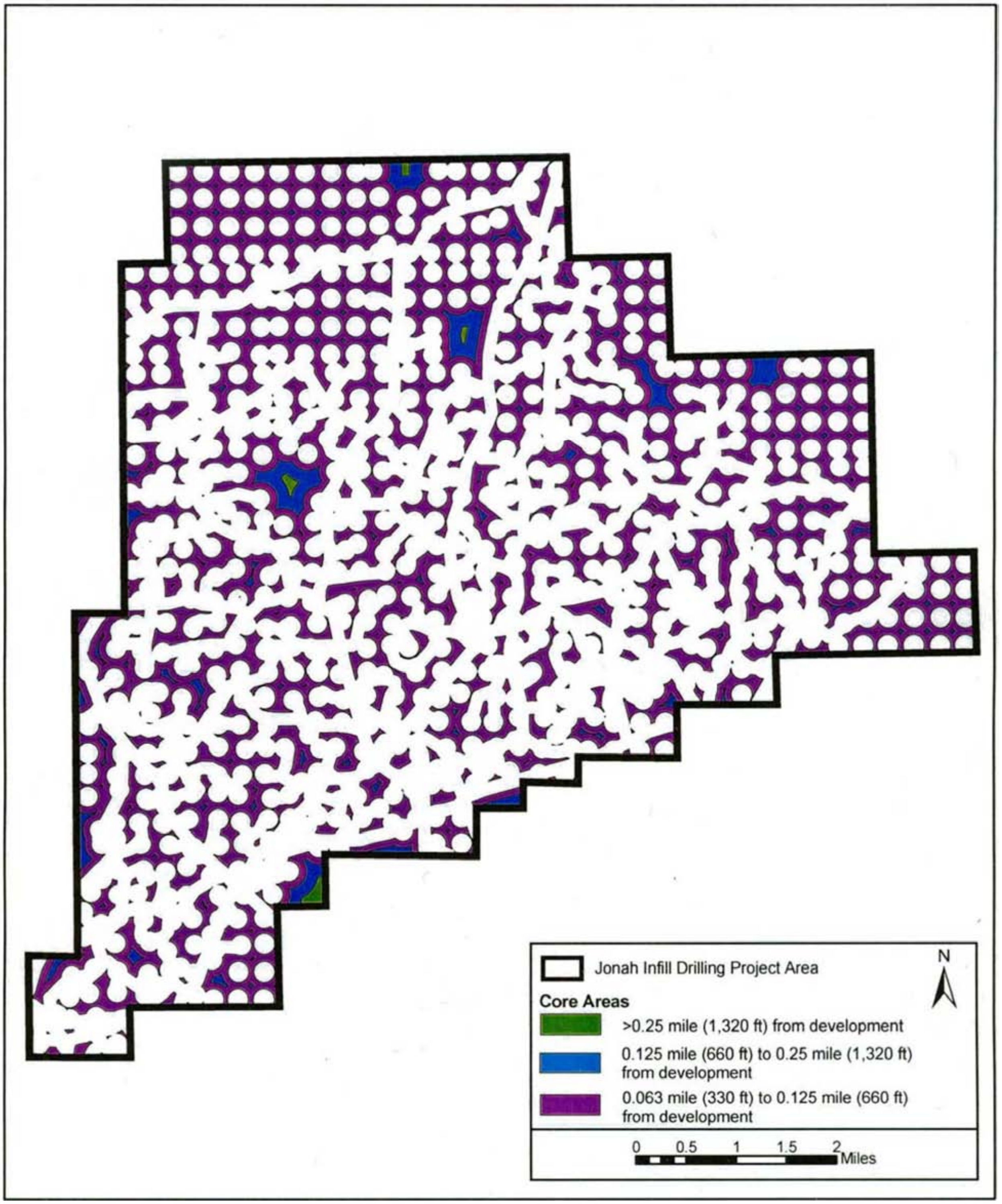
Table 4.14. Number and Mean Size of Core Areas in the JIDPA for Existing Conditions and Possible Development Scenarios, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Disturbance Buffer	Number/Mean Size of Core Areas (acres)			
	Existing Conditions	16 Wells/Section	32 Wells/Section	64 Wells/Section
0.063 mile	164/84	205/42	616/5	93/7
0.125 mile	119/62	237/3	64/5	7/33
0.25 mile	18/214	6/10	3/5	2/3
0.5 mile	7/226	0	0	0

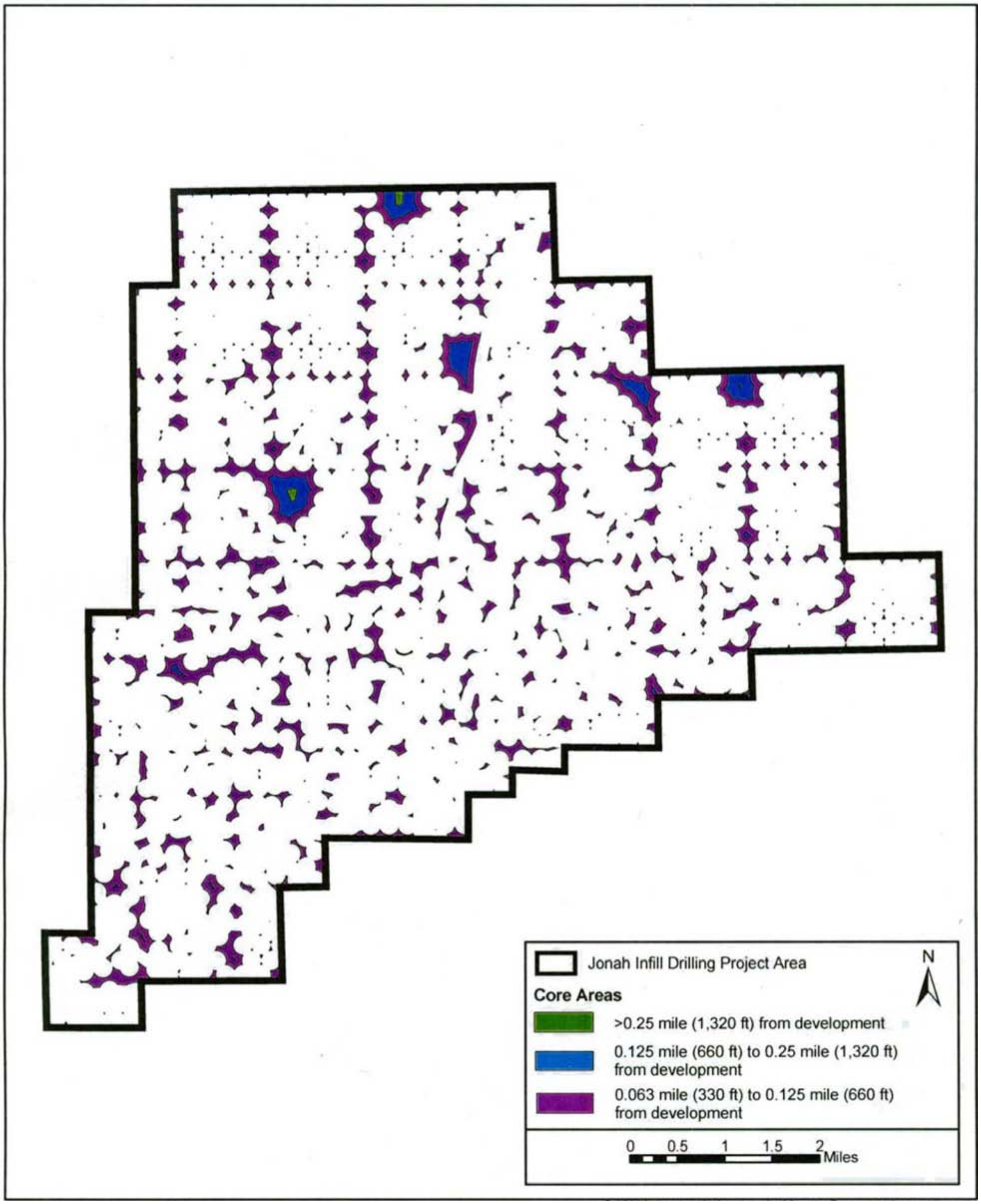
Impacts specific to species or groups of species are described in the following sections. Significant impacts are anticipated under all alternatives (including the No Action Alternative), but would vary in degree as discussed in Sections 4.2.2.1 through 4.2.2.6. Existing and BLM-proposed mitigation for many wildlife species may be inadequate to reduce impacts to less than significant levels in the JIDPA.



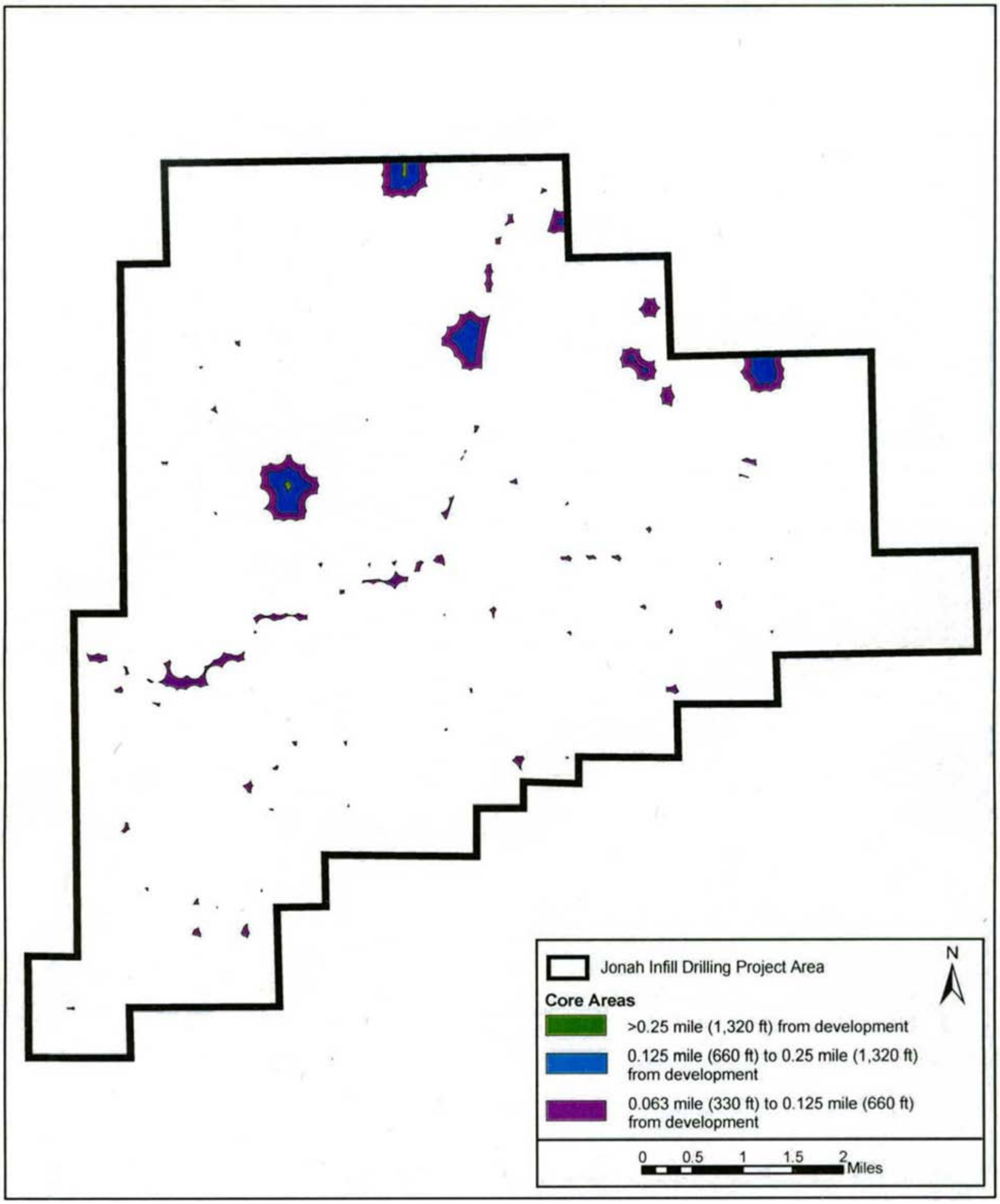
Map 4.2. Existing Wildlife Habitat Fragmentation (No Action), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



Map 4.3. Wildlife Habitat Fragmentation Expected Under Development at 16 Wells per Section (Alternative E), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



Map 4.4. Wildlife Habitat Fragmentation Expected Under Development at 32 Wells per Section (Alternative F), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.



Map 4.5. Wildlife Habitat Fragmentation Expected Under Development at 64 Wells per Section (Alternative G), Jonah Infill Drilling Project, Sublette County, Wyoming, 2006.

Pronghorn Antelope

Surface disturbance (both short-term and LOP) would result in the direct loss of spring/summer/fall pronghorn habitat within the Sublette Herd Unit. This would include up to 0.7% of the 4,697 square miles of spring/summer/fall habitat for the herd and up to 0.4% of the 7,938 square miles of occupied habitat (spring/summer/fall/winter combined), depending on the alternative. No crucial pronghorn habitats would be disturbed in the JIDPA as a result of the proposed project. Upgrading the Burma Road in the Proposed Action and Alternative A would have negligible effects on crucial winter pronghorn habitat. Approximately 65–71% (depending on the alternative) of the disturbed areas would be reclaimed and revegetated shortly after disturbance. This short-term disturbance would occur within spring/summer/fall habitat and would be spread over the development period and scattered throughout the JIDPA. The remaining 29–35% of the disturbance acreage would result in the removal of spring/summer/fall habitat on the Sublette Herd for the LOP and until successful reclamation and revegetation is achieved. Reclaimed and revegetated areas would produce less forage for a period of years until revegetation is successful, at which time grasses and possibly forbs would become more dominant. Shrubs likely would take 30 to 40 years or more to become established but may take more than 100 years to reach predisturbance productivity and structure levels (Braun 1998, Slater 2003). In the interim, habitat function for sagebrush obligate species such as pronghorn would be compromised to varying degrees.

In addition to the direct loss of habitat, disturbance from drilling activities (including noise, increased traffic volume, and human presence) would indirectly affect utilization of habitats adjacent to development areas. Depending on the severity of these indirect impacts, pronghorn displacement distance could be about 0.5 mile (Gusey 1986, Guenzel 1987, Easterly et al. 1991). However, as noise and human presence are reduced (e.g., during production operations), pronghorn likely would increase their use of otherwise suitable habitats, although probably not to the same extent as prior to disturbance. Although methodologies for documenting animal displacement or changes in distribution are fairly straightforward, those for documenting population-level impacts (i.e., survival and reproduction) are extremely complex. Thus, little information is available concerning how human-related disturbances impact reproduction and survival of ungulates (Western EcoSystems Technology Inc. [West] 2003).

Because the Jonah Infill Project would disturb pronghorn spring/summer/fall range, it is reasonable to assume that the project would have some adverse impacts to pronghorn populations as a result of direct habitat removal and a reduction in habitat function on areas adjacent to development activities. However, specific quantitative estimates of such impacts are not possible because the requisite research has not been done. Lindzey (2002), commenting on impacts to big game from oil and gas development, said:

> Changes resulting from energy development, undoubtedly, will influence wildlife populations, yet little [research] is available to support inferences about the degree of population-level effects or the best way to address possible impacts. Understanding the population-level effects of disturbances, such as those realized during energy exploration and development require more than the short-term, observational studies biologists now have to rely on.

Reeve (1984) found that pronghorn habituated to increased traffic volumes and heavy machinery noise as long as traffic moved in a predictable manner. Reaction of pronghorn to roads is not well understood; however, pronghorn are often seen adjacent to road ROWs, including busy interstate highways. It is likely that pronghorn movement is more affected by fences along ROWs than by the activity (traffic) on the ROW. However, increased mortality from vehicle/animal collisions is a potential direct impact that may occur due to increased traffic on the JIDPA for the LOP, and the provision of access to big game range may increase legal and illegal pronghorn harvest. On the other hand, some people may be deterred from poaching because of the increased number of vehicles and humans in the area and the subsequent likelihood of being observed by other area visitors.

Pronghorn are known to move through the JIDPA on their way to and from crucial habitats (see Map 3.13), and some of these movements are likely to be hindered under most, if not all, of the development alternatives. However, no peer-reviewed scientific literature exists to assess possible energy-related effects on migration of the Sublette Herd Unit (Berger 2003). The existing migration corridor between U.S. Highway 191 and the JIDPA boundary is at least 1.0 mile wide and would remain undisturbed (excluding the existing and unfenced Luman, Jonah North, and Rim Roads).

Furbearers, Small Game, and Other Mammals

Impacts to furbearers, small game, and other mammals would include the direct loss of habitat due to surface disturbance. Total proposed surface disturbance represents up to 67% of the JIDPA (depending on the alternative), and some unknown portion of the undisturbed habitat likely would suffer a reduction in use because of its proximity to human activity (noise, traffic, etc.). The degree of loss of habitat function would, to some extent, depend on each species' ability to adapt to disturbance. In addition, some smaller, less mobile animals like mice, voles, and ground squirrels are likely to be killed during construction operations.

Some additional poaching and increased mortality from animal/vehicle collisions is likely due to the increased road and traffic volume associated with project activities. The ability of the lands within the JIDPA to support furbearers, small game, and other mammals likely would decrease from current levels due to habitat loss and human disturbance. Increased human activity would displace some species from areas near project features which, when coupled with direct habitat loss, would further fragment habitats. Populations would continue to fluctuate and impacts would be masked by natural variations in weather, incidence of disease, and other natural factors. Project-related disturbance to rare habitats (e.g., wetlands) would be avoided where practical (no other rare habitats are currently known to occur on the JIDPA).

Raptors

Existing seasonal and spatial restrictions at active raptor nests are intended to prevent adverse impacts (e.g., frightened adults, overexposure of eggs or young to heat or cold, missed feedings, premature fledging, and increased predation) to breeding, nesting, and brood-rearing raptors. However, no restrictions are in place to prevent development within the seasonal buffer zone outside of the nesting season except for the 825-foot or 1,000-foot no surface occupancy (NSO) buffers, and project facilities and roads constructed outside of the nesting season could result in disturbance to nesting activities in subsequent years. Tolerance to disturbance varies among raptor species and among individuals of the same species. In general, ferruginous hawks are among the most sensitive species to human disturbance. In some instances, raptor nest disturbance and the associated decrease in reproductive success may be avoided if project facilities are located outside of the line-of-sight of active raptor nests and/or if other raptor protection measures are effective. However, if suitable nesting habitat as identified during pre-development surveys is determined to be unoccupied by raptors, development may be allowed in these areas potentially precluding the future use of these areas by nesting raptors. The potential for adverse impacts to raptors would be greatest during project development, when human activity levels are highest; it is anticipated that impacts would decrease somewhat during the production phase of the project.

Reduction in raptor prey species also is likely to occur as a result of the surface disturbance of up to two-thirds of the JIDPA (the amount of disturbance would depend on the alternative). This habitat loss and the associated decrease in available prey base would reduce the quality of raptor foraging habitat within the JIDPA and may increase the size of foraging territory necessary to support an individual and/or decrease the number of foraging raptors the area can support.

Throughout the LOP, it is likely that raptor productivity (especially that of ferruginous hawks) would be negatively impacted by project-related activities. Increased human activity associated with the proposed project is likely to result in fewer nest initiations, increased nest site abandonment and/or reproductive failure, and decreased productivity of successful nests.

Game Birds

Disturbance of breeding, nesting, brood-rearing, and wintering greater sage-grouse and their habitats would increase from that currently occurring in the JIDPA as a result of increased habitat removal and noise and traffic associated with increased human presence. The currently identified 0.25-mile active lek buffer and other seasonal avoidance measures may be inadequate to protect breeding, nesting, brood-rearing, and wintering grouse from noise or other impacts within the JIDPA (e.g., individuals flushed from leks, failure of females to breed, lek and nest abandonment, avoidance of habitat), which could result in reduced breeding initiation, reproductive success, and survival. The locations of known leks (see Map 3.19) on and adjacent to the JIDPA are assumed to represent optimal lek habitat. Impacts to leks and other important habitats (nesting, winter) may be serious enough to cause abandonment of the area. Even if alternate lek sites are established or existing leks at alternate locations are used, it is assumed that less than optimal conditions would prevail, resulting in decreased breeding success, even though lek availability is not considered to be a limiting factor for sage-grouse (USFWS 2005d). Furthermore, the loss of nesting, brood-rearing, and wintering areas may be equally, if not more, important to grouse survival. As with raptor nests, site-specific situations vary, and the success in reducing impacts using standard mitigation measures (e.g., NSO buffers and seasonal timing restrictions) is variable.

Although greater sage-grouse still use the JIDPA, the direct and indirect impacts of previous developments in the JIDPA may have already rendered the area unsuitable for long-term sage-grouse use. Further habitat loss and disturbance would occur under all action alternatives. Recovery of habitat functionality for greater sage-grouse may take over 100 years (Braun 1998, Slater 2003). However, it is anticipated that a mosaic of sagebrush habitat age classes would be available on the JIDPA within a shorter time frame.

In areas where 40% of greater sage-grouse nesting, early brood-rearing, and/or winter habitat has been lost or severely degraded within the range of a population, Connelly et al. (2000) suggest that the management emphasis should focus on protecting any remaining sagebrush that is in any way suitable for these functions. Disturbance to remaining suitable greater sage-grouse nesting, early brood-rearing, and winter habitats should be avoided to prevent further fragmentation of those habitats. Within comparatively intact sagebrush ecosystems, restoring up to 20% of degraded nesting and early brood-rearing habitats and 30% of the winter habitat may improve habitat conditions. Restoration treatments may consist of providing herbaceous understory, creating open patches of herbaceous vegetation, thinning dense sagebrush canopies exceeding

30% cover, creating openings within dense sagebrush, regenerating the shrub component by setting back succession, or enhancing herbaceous understory by reducing herbivory. However, at some point, it becomes ineffective to mitigate habitat loss by restoring vegetation because the temporary loss of nesting and roosting habitat and decreased food availability during treatment and mitigation creates an unacceptable level of impacts to greater sage-grouse (Connelly et al. 2000). Optimal food availability allows sage-grouse to minimize brood movement during foraging, thereby lowering predator exposure and energetic costs of foraging (Lyon 2000). With decreasing availability of forbs and grasses, broods move longer distances and expend more energy to find forage. This increased movement, in addition to decreased vegetative cover, may expose chicks to greater risk of predation (Lyon 2000).

A study on coal mining activities and oil field development in North Park, Colorado, found that greater sage-grouse populations in areas experiencing disturbance decreased in relation to surrounding undisturbed populations (Braun 1986, 1987). Because adult male greater sage-grouse establish fidelity to specific leks, Braun (1986) hypothesized that mining activity and large-scale habitat loss occurring adjacent to leks may contribute to a reduction in the number of yearling male recruits to those areas and that the increased road construction associated with such development also may impact greater sage-grouse populations. Road construction results in permanent travel routes, improved public access, increased long-term traffic-related disturbance in previously inaccessible regions, indirect noise impacts to leks, and direct mortality (Braun 1998). Roads also provide a clear pathway for predators to move unimpeded by vegetation or other obstructions (Lyon 2000). The road-effect distance, or the distance from a road at which a population density decrease is detected, is positively correlated with increased traffic density and speed and is more critical in years when wildlife populations are low (Forman and Alexander 1998). Studies conducted in Montana, Wyoming, and Colorado suggest that some recovery of greater sage-grouse populations may occur after a site has been developed and subsequently reclaimed following energy development, road construction, and other human disturbances (Braun 1998). However, there has been no evidence that populations attain their pre-disturbance levels.

Female greater sage-grouse also demonstrate site fidelity to nesting areas surrounding a lek (Schroeder et al. 1999; Lyon 2000). Female yearlings nest in the same area in which they hatched (Lyon 2000). Even in areas of high disturbance, females continue to maintain their site fidelity, though not without some behavioral modifications. The results from a study conducted by Lyon (2000) indicate that hens captured on disturbed leks demonstrate lower nest initiation rates, travel twice as far to nest sites, and select higher total shrub canopy cover and live sagebrush canopy cover than hens captured near undisturbed leks. The average distances between nests and the nearest lek varies from 0.7 to 3.9 miles; however, one female nested more than 12.4 miles from the nearest lek. Lyon (2000) found 74% of the hens captured from disturbed leks nested more than 1.9 miles from the lek, while 91% of the hens from undisturbed leks nested within 1.9 miles of the lek. Females that nest >2.0 miles from a lek are less likely to be protected under current BLM stipulations. Although information is not available regarding minimum sagebrush patch sizes required by sage-grouse (USFWS 2005d), maintaining large, continuous tracts of suitable habitat protected from disturbance is likely critical to the sustainability of greater sage-grouse populations.

Field development also could reduce the value of some greater sage-grouse winter habitat, although some grouse winter habitat would remain on and adjacent to the JIDPA (especially within the Sand Draw buffer).

Further identification of potential greater sage-grouse impacts would be provided during annual inventory and monitoring (TRC Mariah 2004a), and additional protection measures may be applied in the JIDPA as directed by BLM.

Mourning doves are seasonal (summer) visitors in the JIDPA and populations likely would not be impacted by the Proposed Action because of their relatively high tolerance to human activity and presence, their inherent mobility, and the availability of suitable habitat on adjacent lands.

Other Birds

Non-game birds would be adversely affected by increased development in the JIDPA. Primary impacts to any given species would occur in direct proportion to the amount of suitable habitat removed (up to 67% of the JIDPA, depending on the alternative). Secondary impacts would include temporary displacement from potentially suitable habitat resulting from human disturbance. Approximately 65-71% of new disturbance (depending on the alternative) would be reclaimed and revegetated during the LOP; however, in sagebrush communities (the dominant predisturbance vegetation type in the JIDPA), it may take decades to recover the functional value of the habitat. Wyoming big sagebrush may require 30 to 40 years to become established and may take more than 100 years to achieve desirable habitat characteristics (e.g., canopy height, coverage, and area) (Braun 1998, Slater 2003). Thus, impacts, particularly for sagebrush-obligate bird species, could persist for decades after the LOP. Some increased mortality also is likely to occur due to vehicle/bird collisions resulting from increased traffic.

Amphibians and Reptiles

Direct impacts to amphibians and reptiles would occur in direct proportion to the amount of habitat disturbed. Total surface disturbance in the JIDPA would be up to 67% (depending on the alternative). However, 65-71% of that disturbance would be short term, and wetlands and WUS generally would be avoided. An increase in mortality due to increased traffic is also anticipated as a result of the proposed project.

All Species

Impacts to most wildlife resources would be proportional to the amount of habitat lost, both directly (see Section 4.2.1) and indirectly, and the duration of the loss. While a variety of mitigation/protection measures would be applied across alternatives (see Chapter 2 and Appendices A and B), significant adverse impacts to some wildlife resources are anticipated under all alternatives including the No Action Alternative. These impacts have been identified in the JIDPA during annual wildlife monitoring of the area (e.g., TRC Mariah 2004a). Impacts noted during annual wildlife monitoring include non-attendance or decreased attendance by greater sage-grouse on some known leks, absence/decline in greater sage-grouse nesting, brood-rearing, and wintering in the area, and inactivity and failure of some raptor nests and/or nesting territories (particularly for ferruginous hawks). These existing impacts to wildlife species and their habitats would be exacerbated with the implementation of the alternatives and the accompanying direct and indirect disturbances.

The degree of current habitat fragmentation within the JIDPA is high, with 87.40% of the lands in the JIDPA being within 0.25 mile (1,320 feet) of project-related disturbance and 75.70% of the lands being within 0.125 mile (660 feet) (see Table 4.13). Depending on the alternative, up to 99.98% of the JIDPA would be within 0.25 mile (1,320 feet) of project-related disturbance, and up to 99.20% would be within 0.125 mile (660 feet). Furthermore, patch sizes for areas greater than 0.25 mile from project-related disturbance would be reduced from the current average of 214 acres to as small as 3 acres (see Table 4.14). Although, as recognized above, insufficient scientific research has been conducted to determine what level of fragmentation is critical for individual populations or species, this level of disturbance is very likely a significant impact under all alternatives for at least some of the species of wildlife that inhabit the JIDPA.

The aforementioned impacts (direct habitat loss, temporary or permanent displacement from existing habitat resulting from human disturbance, and habitat fragmentation) are significant to the majority of wildlife species within the JIDPA and on adjacent lands under all alternatives.

Wildlife impacts due to increased mortality from construction, traffic, and poaching are not anticipated to be significant on either a local or a management area level under any alternative.

Based on existing research data and observations of pronghorn reactions to oil and gas development, impacts on pronghorn populations in the Sublette Herd Unit resulting from development of the JIDPA, including habitat fragmentation and a reduction in habitat quality, are anticipated to be less than significant on both a local and a management area level. No loss of pronghorn migration routes is anticipated, although pronghorn may alter their migration routes to avoid project disturbances. The project would not result in any changes to existing migration bottlenecks outside the JIDPA.

4.2.2.1 No Action Alternative

Direct wildlife habitat loss resulting from 4,209 acres of short-term and 1,409 acres of LOP disturbance is currently approved within the JIDPA (BLM 1998b, 2000b) for ongoing natural gas development and production. Under the No Action Alternative, no additional direct or indirect impacts to wildlife species from natural gas development would occur in the JIDPA because no additional habitat disturbance would be approved beyond levels listed above. No further habitat fragmentation or displacement would occur beyond current levels (see Map 4.2 and Tables 4.13 and 4.14); however, considerable habitat fragmentation already exists in the JIDPA, and the area may no longer be suitable for the long-term sustainability of some wildlife species. Impact duration would be approximately 63 years plus the time needed for successful reclamation. Impacts to most wildlife species on the JIDPA would be significant; however, no additional significant impacts beyond those of previously authorized actions are anticipated.

4.2.2.2 The Proposed Action

The Proposed Action would result in an estimated increase (over the No Action Alternative) of 16,200 acres of new disturbance, which when combined with existing disturbance, would result in a total of 20,409 acres of project-related surface disturbance. All of the new disturbance would be within pronghorn Sublette Herd Unit spring/summer/fall habitat. This represents 0.68% of the 4,697 square miles of spring/summer/fall habitat for the herd and 0.40% of the 7,938 square miles of all potential habitat (spring/summer/fall/winter combined). Approximately 70.4% of the total impact area (14,388 acres) would be short-term disturbance. The remaining 29.6% (6,043 acres) would remain disturbed for the LOP. In addition to the direct loss of habitat, disturbance from drilling and production activities (including noise, increased traffic volume, and human presence) would indirectly affect utilization of habitats adjacent to development areas. However, selected Operator-committed and BLM-required practices for the avoidance of sensitive areas would be implemented. Impact duration would be approximately 76 years plus the time needed for successful reclamation, or approximately 13 years longer than the No Action Alternative. Impacts to most wildlife species on the JIDPA would be significant.

4.2.2.3 Alternative A

Implementation of Alternative A would result in the same types and acreages of impacts to wildlife species as the Proposed Action (i.e., 16,200 acres of new disturbance and 4,631 acres of LOP over the No Action Alternative). However, under Alternative A, selected Operator-committed and BLM-required practices for the avoidance of sensitive areas (e.g., avoidance of the Sand Draw drainage [300-foot buffer either side], greater sage-grouse leks, and raptor nests) would not occur. This likely would result in increased impacts to greater sage-grouse, raptors, and other wildlife species. Habitat fragmentation under this alternative would result in all areas within the JIDPA being within 330 feet of project disturbance. Impact duration would be approximately 76 years plus the time needed for successful reclamation, or approximately 13 years longer than the No Action Alternative. Impacts to most wildlife species on the JIDPA would be significant.

4.2.2.4 Alternative B

Alternative B would result in an estimated increase (over the No Action Alternative) of 3,222 acres of new disturbance, for a total of 7,431 acres of project-related surface disturbance in the area. Approximately 65% (4,848 acres) of the total disturbance would be short term, and the remaining 35% (2,602 acres) would remain disturbed for the LOP. Areas of the JIDPA that currently lack well pads would have minimal new surface disturbance because this alternative does not allow for construction of new well pads, roads, or gathering pipelines. Habitat fragmentation would not increase significantly relative to the No Action Alternative (see Map 4.2). Impact duration would be approximately 105 years plus the time needed for successful reclamation, or approximately 42 years longer than the No Action Alternative. Impacts to most wildlife species on the JIDPA would be significant.

4.2.2.5 BLM Preferred Alternative

The Preferred Alternative would result in an increase (over the No Action Alternative) of a minimum of 9,821 and a maximum of 16,125 acres of new surface disturbance. Approximately 71% (6,971 to 11,577 acres) of the total disturbance would be short term, and the remaining 29% (2,858 to 4,611 acres) would remain disturbed for the LOP (see Table 2.5). Because the specific locations of future well pads are unknown, habitat fragmentation cannot yet be evaluated. Impact duration would be approximately 76 years plus the time needed for successful reclamation, or approximately 13 years longer than the No Action Alternative (see Table 2.1). Impacts to most wildlife species on the JIDPA would be significant.

Total disturbance would be comparable to that of the Proposed Action if the Operators maximize ongoing reclamation as described in Section 2.4.5 (i.e., 20,234 acres vs. 20,409 acres). However, under the Preferred Alternative, additional mitigation measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5). These measures would moderate, to some extent, anticipated impacts to wildlife species.

4.2.2.6 Cumulative Impacts

CIAAs for wildlife and fisheries vary by resource. While the principal focus of the following analysis is cumulative impacts from oil and gas development, other actions in each CIAA have affected and will continue to affect wildlife. These actions include, but are not limited to, urbanization, the proliferation of roads (in addition to those for oil and gas development), WGFD species management and associated hunter harvests, livestock grazing, and recreation.

For the following cumulative impacts discussion, impacts to CIAAs under the five alternatives discussed herein can be ranked based on new and LOP disturbance acreages, with the following caveats.

- Although new and LOP disturbance under the Proposed Action and Alternative A are the same, impacts would be greater under Alternative A because selected Operator-committed practices and BLM development guidelines and stipulations would not be implemented.
- Under the Preferred Alternative, impacts may be lower than implied by disturbance acreage alone, because BLM management and monitoring requirements designed to protect resources and minimize impacts while meeting field development objectives would be implemented.

The Proposed Action and Alternative A would result in the most surface disturbance within the JIDPA (i.e., 20,409 acres new and 6,043 acres LOP disturbance). If the Operators maximize ongoing reclamation as described in Section 2.4.5, total acres affected under the Preferred Alternative would be almost as high (20,334 acres). However, under the Preferred Alternative total surface disturbance at any given time would be limited to a maximum of 14,030 acres, whereas the maximum disturbance at one time would be unregulated under the other alternatives. Alternative B has the lowest anticipated disturbance acreage of any of the action alternatives, with 7,431 acres of new disturbance and 2,602 acres of LOP disturbance. Under the No Action Alternative, disturbance would be limited to that already approved—4,209 acres total and 1,409 acres LOP disturbance.

<u>Pronghorn Antelope</u>

The CIAA for pronghorn is the Sublette Herd Unit (see Map 3.13). The impacts of oil and gas development on pronghorn in the Herd Unit are largely unknown, but the WGFD indicates that pronghorn have and will continue to redistribute spatially, and that mortality may increase due to habitat loss (WGFD 2001). Avoiding a loss of habitat function on crucial winter range is especially important to maintaining pronghorn populations at a desired level. In addition, there are several migratory "bottlenecks" through which some Sublette Herd Unit pronghorn move (to and from winter range). These bottlenecks are created by natural topography and/or human activity and keeping them open is crucial to the continued survival of portions of the Sublette Herd. Efforts have been initiated to mitigate the impacts to pronghorn movement through these bottlenecks. Fences, particularly those along highways, also restrict pronghorn movements and hinder use of seasonal ranges. New highway construction may further restrict pronghorn movement and further fragment habitat. None of the alternatives would adversely affect known pronghorn crucial winter range or bottlenecks beyond a negligible degree; therefore, they would not contribute to cumulative impacts to these habitat features.

Under the Preferred Alternative, between 1.6% and 1.7% of spring/summer/fall range in the Sublette Herd Unit would be disturbed and habitat function on an unknown amount of adjacent habitat would be reduced. The Proposed Action and Alternative A would be similar to the maximum allowable impact under the Preferred Alternative; these alternatives would result in approximately 1.7% disturbance to spring/summer/fall range in the Sublette Herd Unit. Based on these relatively low levels of disturbance, it is not anticipated that any of these alternatives would measurably add to cumulative impacts to the Sublette Herd Unit. RFD for the Sublette Herd Unit includes 1,591 wells, additional roads, and other related development disturbing more than 12,000 acres, bringing the maximum cumulative development (existing disturbance, disturbance from the proposed project, and disturbance from RFD) within the Herd Unit to 97,000–113,200 acres, or approximately 1.4–1.7% of the area (Table 4.15). Indirect habitat loss (loss of habitat function resulting from human disturbance) would occur on an additional but unknown amount of land. The magnitude of these indirect impacts on the Sublette Herd Unit is unknown and cannot be predicted (WGFD 2001); however, these impacts are not anticipated to be cumulatively significant.

Furbearers, Small Game, and Other Mammals

The CIAA for furbearers, small game, and other mammals is depicted in Map 3.14 and is otherwise known as the Jonah Wildlife Study Area.

RFD for the CIAA includes 1,014 acres primarily associated with oil and natural gas development in the Pinedale Anticline Project Area (see Table 4.15). Cumulative impacts resulting from development are anticipated to be similar in kind to those described for the proposed project but would include the additional developments associated with the Pinedale Anticline Project. Developments would result in additional cumulative impacts to small mammals due to direct and indirect habitat loss, habitat fragmentation, increased traffic volumes, and increased vehicle/small mammal collisions. Recreational hunter harvest of small game and shooting of prairie dogs and other small non-game mammals are also anticipated to increase as a result of increased access to the area. The increased mortality experienced by small mammal populations also would have a cumulative impact on predator species (e.g., raptors, foxes, coyotes, badgers, etc.) that depend on small mammal populations for prey. Cumulative disturbance within the Jonah Wildlife Study Area CIAA would range from 4.2% to 12.8% of the area, with up to 12.7% disturbance under the Preferred Alternative (see Table 4.15). Impacts generally would be in proportion to the amount of direct habitat loss and are anticipated to be less than significant.

Raptors

The CIAA for raptors is depicted in Map 3.16.

RFD disturbance in the CIAA includes 2,862 acres (see Table 4.15) and is primarily associated with natural gas development described for the Pinedale Anticline Project. Between 10.1% and 11.5% of the CIAA would be disturbed depending on the alternative—up to 11.5% would be disturbed under the Preferred Alternative (see Table 4.15).

All raptor nests in the Pinedale Anticline Project Area are protected by No Surface Occupancy buffers year-round and active nests are protected during the nesting season by timing restrictions and seasonal buffers. Monitoring of raptor nests in the Pinedale Anticline and Jonah Field Wildlife Study areas is conducted annually (TRC Mariah 2004a, 2004b). The results of these investigations have led to the application of additional mitigation (artificial nest structure placement) and it is likely that mitigation opportunities will continue to identified in the future.

Raptors using the JIDPA and CIAA for nesting and foraging would likely experience continued adverse effects, which could lead to reductions in the regional reproductive success of raptors in the CIAA. These adverse effects are anticipated to be cumulatively significant.

Table 4.15. Potentially Disturbed Acreage in Each Wildlife CIAA, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Cumulative Impact Analysis Area (CIAA)	Total Acreage of CIAA	Existing Disturbance in CIAA, outside JIDPA	RFD	Disturbance											
				No Action			Proposed Action and Alternative A			Alternative B			Preferred Alternative		
				JIDPA total	LOP	Cumulative[1]	JIDPA total	LOP	Cumulative[1]	JIDPA total	LOP	Cumulative[1]	JIDPA total	LOP	Cumulative[1]
Sublette Antelope Herd Unit	6,727,270	80,791	12,000	4,209	1,409	97,000	20,409	6,043	113,200	7,431	2,602	100,222	14,030–20,334	4,267–6,020	106,821–113,125
Percent of Entire CIAA		0.01				1.4			1.7			1.5			1.6–1.7
Jonah Wildlife Study Area	188,888	2,729	1,014	4,209	1,409	7,952	20,409	6,043	24,152	7,431	2,602	11,174	14,030–20,334	4,267–6,020	17,773–24,077
Percent of Entire CIAA		1.4				4.2			12.8			5.9			9.4–12.7
Raptors	1,184,443	113,092	2,862	4,209	1,409	120,163	20,409	6,043	136,363	7,431	2,602	123,385	14,030–20,334	4,267–6,020	129,984–136,288
Percent of Entire CIAA		9.5				10.1			11.5			10.4			10.9–11.5
Greater Sage-grouse	1,061,805	28,767	1,716	4,209	1,409	34,692	20,409	6,043	50,892	7,431	2,602	37,914	14,030–20,334	4,267–6,020	44,513–50,817
Percent of Entire CIAA		2.71				3.2			4.8			3.6			4.2–4.8

[1] Cumulative disturbance = outside JIDPA + RFD + JIDPA total

Game Birds

The CIAA for greater sage-grouse is depicted in Map 3.18. There are approximately 52 known leks in the CIAA, with the highest percentage of those occurring east of Highway 191.

RFD in the CIAA includes 1,716 acres and is primarily associated with oil and gas development (see Table 4.15). Depending on the alternative, disturbance within the CIAA would range from 3.2 to 4.8% of the area; disturbance under the Preferred Alternative would be up to 4.8%.

The proposed project and RFD likely would result in some disturbance to nesting, brood-rearing, and wintering greater sage-grouse. Although the magnitude of the impact resulting from that disturbance is unknown, it is anticipated that the impact would contribute to the decline in regional greater sage-grouse populations and therefore be cumulatively significant.

The CIAA for mourning dove is the Jonah Field Wildlife Study Area (see Map 3.14). No significant cumulative impacts to mourning doves are anticipated.

Other Birds

The CIAA for other birds is the Jonah Field Wildlife Study Area (see Map 3.14). Little additional project-related disturbance is anticipated in the Wildlife Study Area outside the JIDPA, other than that for the Burma Road upgrade and impacts occurring for the Pinedale Anticline Project. Impacts generally would be in proportion to the amount of direct habitat loss and are anticipated to be less than significant.

Amphibians and Reptiles

The CIAA for amphibians and reptiles is the Jonah Field Wildlife Study Area (see Map 3.14). Little additional project-related disturbance is anticipated in the Wildlife Study Area outside the JIDPA, other than the Burma Road upgrade that would disturb the area adjacent to existing disturbance, and impacts occurring for the Pinedale Anticline Project. Impacts to amphibians and reptiles would generally be in proportion to the amount of direct habitat loss and are anticipated to be less than significant.

Fisheries

The CIAA for fisheries includes all 10 project-affected watersheds (see Map 3.9), the same CIAA as for soils, surface waters, and vegetation. Affected drainages include Expanded Sand Draw-Alkali Creek, Granite Wash, Reduced Upper Alkali Creek-Green River, Big Sandy River-Bull Draw, Long Draw, Upper Eighteen Mile Canyon, Jonah Gulch, 140401040603, North Alkali Draw, and Southeast New Fork River-Blue Rim. Project-affected drainages do not support fish; therefore, cumulative impacts to fisheries would not be significant. See Section 4.1.8.6 and Table 4.6 for further information regarding cumulative disturbance within these watersheds.

4.2.2.7 Unavoidable Adverse Impacts

Unavoidable impacts to wildlife would include habitat loss, due to both direct surface disturbance/vegetation removal, and reduction in habitat quality due to project-related activities such as increased traffic, noise, and human presence. Some direct mortality to small mammals during construction and from project traffic/vehicle collisions is also likely to occur.

4.2.3 Threatened, Endangered, Proposed, and Candidate and BLM Wyoming Sensitive Species

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (Wyoming State Land Use Commission 1979) and Sublette County (Sublette County Board of Commissioners and Sublette County Planning Commission 2003) identify the following management goals/objectives associated with wildlife and fisheries, including BLM Wyoming Sensitive Species (BWS). These goals/objectives are also relevant for TEP&C species:

- to maintain, improve, or enhance the biological diversity of all plant and wildlife species while ensuring healthy ecosystems;
- to restore disturbed or altered habitat with the objective to attain desired native plant communities, while providing for wildlife needs and soil stability; and
- to conserve and develop recreational resources for the benefit of present and future generations;
- to consider wildlife migration corridors, crucial winter ranges, and other important habitats when evaluating land use proposals;
- to support and maintain healthy wildlife populations as an appropriate and desired land use;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds; and
- to minimize conflicts between wildlife and domestic pets.

Impacts to federal TEP&C species would be considered significant if any project action adversely affected or jeopardized these species or their critical habitat and/or any recovery program. Impacts to BWS species would be significant if project activities contributed to the federal listing of any BWS species. BLM prepared a Biological Assessment of potential impacts of the JIDP on federally listed species and submitted it to the USFWS on October 25, 2005, with a request for formal consultation on the Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker. In a letter dated December 16, 2005, the USFWS agreed to initiate formal consultation on the potential effects of the JIDP (see Appendix H). The USFWS expects to issue a Biological Opinion in January 2006.

4.2.3.1 Threatened, Endangered, Proposed, and Candidate Species

None of the alternatives are likely to adversely impact black-footed ferret, bald eagle, or Ute ladies'-tresses given their current absence from the JIDPA (see below) and the implementation of appropriate mitigation measures (see Chapter 2 and Appendices A and B). However, project-related groundwater depletions may adversely affect the four endangered fishes (Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker).

<u>Black-footed Ferret</u>

Black-footed ferrets are not known to occur, nor are they likely to occur, within the JIDPA, and the JIDPA and vicinity have been block-cleared for ferrets by the USFWS (i.e., surveys for ferrets are not required in the area because USFWS has concluded that their presence in the area is unlikely) (USFWS 2004). However, should ferrets be discovered in the JIDPA, formal consultation would be initiated with the USFWS to ensure their protection and management.

Bald Eagle

No bald eagle nests or winter roosts are known to occur on the JIDPA; however, they do use the Green and New Fork River corridors north of the JIDPA for nesting and migration and may occasionally forage in the JIDPA. It is anticipated that bald eagles would avoid the JIDPA for the LOP and would move to other suitable foraging areas in the region.

Fish

The four species of endangered fish present in the Green and Colorado Rivers below Flaming Gorge Dam would not be affected by sedimentation from any alternative because sediment traps and catchments are proposed for the Jonah Field, and the Fontenelle and Flaming Gorge Reservoirs would serve as macro-scale traps/catchments for any turbidity or sedimentation that may reach the Green River. However, 1,225 acre-ft of groundwater a year would be pumped under three alternatives (the Proposed Action, Alternative A, and the Preferred Alternative), and 367.5 acre-ft a year would be pumped under Alternative B. According to the Biological Assessment prepared for the JIDP, “no data collected … prove that [these] water depletions are not connected to the Colorado River system”; therefore, the groundwater depletions my result in depletions of surface waters occupied by Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker and may indirectly and adversely affect these species. Mitigation would be in the form of paying a “depletion charge” to the Upper Colorado River Endangered Fish Recovery Program.

Ute Ladies’-tresses

Ute ladies’-tresses habitat is not known to occur nor is the species likely to occur within the JIDPA.

4.2.3.2 BLM Wyoming Sensitive Species

Significant impacts to several BWS species, most notably to sagebrush-obligate species, are anticipated within the JIDPA under all alternatives. However, these impacts are not expected to contribute to the federal listing of any BWS species.

Impacts to BWS animal species generally would be similar to those described for wildlife (see Section 4.2.2), whereas impacts to BWS plant species generally would be as described for vegetation (see Section 4.2.1). Vegetation/habitat recovery to approximate predisturbance productivity could take 30 to over 100 years in sagebrush habitats (Braun 1998, Slater 2003). Impacts include 1) the direct loss of habitat due to the removal of vegetation and possible increased weed infestations; 2) displacement (wildlife only) due to disturbance from project-related activities, and increased public access to the JIDPA (indirect habitat loss); 3) habitat fragmentation; 4) direct mortality due to construction activities and animal/vehicle collisions; and 5) potential increased mortality due to poaching and harassment.

<u>Mammals</u>

The best habitat areas for the pygmy rabbit (e.g., basin big sagebrush communities) occur along Sand Draw, and pygmy rabbits do occur in this area both on and adjacent to the JIDPA (TRC Mariah 2004a). Idaho pocket gophers may occur within the JIDPA in areas of shallow, stony soils. White-tailed prairie dog towns have been recorded within the JIDPA, and populations routinely utilize habitats on or close to surface disturbance; thus, prairie dogs may to some degree adapt to the human presence/disturbance associated with the proposed project. Nevertheless, populations of these mammals in the JIDPA would likely decline in the long term due to continued habitat loss, habitat fragmentation, and direct mortality.

<u>Birds</u>

Mountain plovers nest and forage in areas of low, sparse vegetation (often associated with prairie dog towns), and plovers have been observed in the vicinity of the JIDPA during wildlife monitoring efforts (e.g., TRC Mariah 2002, 2004a). Burrowing owls and ferruginous hawks nest and forage in the JIDPA; however, their use of the area appears to be declining in recent years (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). Similarly, greater sage-grouse forage, lek, nest, and winter in the JIDPA, but male lek attendance is declining on some leks on and adjacent to the JIDPA and a decrease in the use of the JIDPA for nesting, brood-rearing, and wintering also appears to be occurring (TRC Mariah 1999, 2001a, 2001b, 2002, 2004a). These declines likely are, in part, associated with increased human activity and disturbance associated with oil and gas activities in the area.

Sagebrush obligate species (i.e., sage thrasher, Brewer's sparrow, and sage sparrow) likely would be adversely affected due to habitat loss/disturbance. This impact is anticipated to be significant under all alternatives. Ingelfinger (2001) reported a 50–60% reduction in sagebrush obligates within 100 meters of roads in the Pinedale Anticline Project Area, likely due to traffic, increased horned lark abundance, and avoidance of habitat edges created by roads. The author suggested that oil and gas development likely would result in a decline in populations of sagebrush obligates and an increase in populations of horned larks, as well as additional nesting opportunities for common ravens on structures associated with gas extraction. Ravens prey on sagebrush-obligate nestlings (Martin and Carlson 1998). Nicholoff (2003) recommends that, for Brewer's sparrow, sage sparrow, and sage thrasher, road construction and other developments that would reduce sagebrush habitat patch size to less than 50 acres be avoided where practical. For loggerhead shrike, another BWS species that occurs within the vicinity of the JIDPA, Nicholoff (2003) recommends minimizing conversion of sagebrush and other shrublands and woodlands to non-native grasslands or croplands.

Populations of long-billed curlew have been declining due to loss of suitable habitat as grasslands are converted to cropland or urban development (Nicholoff 2003). No cropland conversion or urban development is proposed; however, some unknown amount of disturbance and habitat fragmentation could result if suitable habitat is disturbed.

4.2.3.3 No Action Alternative

Currently, a total of 4,209 acres of existing and 1,409 acres of LOP disturbance are approved within the JIDPA (BLM 1998b, 2000b). Under the No Action Alternative, no additional impacts to TEP&C and BWS species from oil and gas development would occur in the JIDPA.

4.2.3.4 The Proposed Action

The Proposed Action would result in an estimated increase (over the No Action Alternative) of 16,200 acres of new surface disturbance, for a total of 20,409 acres of project-related surface disturbance. Most of the disturbance would occur in habitats used by BWS species. Approximately 70.4% of the total disturbance (14,388 acres) would be reclaimed and reseeded as soon as practical after disturbance (i.e., short-term disturbance). The remaining 29.6% (6,043 acres) would remain disturbed for the LOP. Impact duration would be approximately 76 years plus the time needed for successful reclamation, or approximately 13 years longer than the No Action Alternative.

Potential indirect impacts to Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker of pumping 1,225 acre-ft of groundwater a year would be offset by payment of a "depletion charge" to the Upper Colorado River Endangered Fish Recovery Program.

4.2.3.5 Alternative A

Implementation of Alternative A would result in the same types and acreages of impacts to BWS species as the Proposed Action (i.e., an increase of 16,200 acres [11,577 acres of short-term disturbance and 4,361 acres of LOP disturbance] over the No Action Alternative). However, under Alternative A, selected Operator-committed and BLM-required practices (e.g., avoidance of Sand Draw buffer) would not occur; thus, additional impacts to BWS species and their habitats (e.g., pygmy rabbit, ferruginous hawk, burrowing owl, sagebrush-obligate species) would likely occur. Impact duration would be approximately 76 plus the time needed for adequate reclamation, or approximately 13 years longer than the No Action Alternative.

Potential indirect impacts to Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker of pumping 1,225 acre-ft of groundwater a year would be offset by payment of a "depletion charge" to the Upper Colorado River Endangered Fish Recovery Program.

4.2.3.6 Alternative B

Alternative B would result in an estimated increase over the No Action Alternative of 3,222 acres of new disturbance, for a total of 7,431 acres of project-related surface disturbance in the area. All disturbance would occur in habitats used by BWS species. Approximately 65% (4,848 acres) of the total disturbance would be short term, and the remaining 35% (2,602 acres) would remain disturbed for the LOP. Areas of the JIDPA that currently lack well pads would have minimal new surface disturbance because the alternative does not allow for construction of new well pads, roads, or gathering pipelines. Impact duration would be approximately 105 years plus the time needed for adequate reclamation, or approximately 42 years longer than the No Action Alternative.

Potential indirect impacts to Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker of pumping 367.5 acre-ft of groundwater a year would be offset by payment of a "depletion charge" to the Upper Colorado River Endangered Fish Recovery Program.

4.2.3.7 BLM Preferred Alternative

The Preferred Alternative would result in an estimated increase over the No Action Alternative of at least 9,821 and not more than 16,125 acres of new surface disturbance. All disturbance would occur in habitats used by BWS species. Approximately 71% (6,971 to 11,577 acres) of the new disturbance would be short term, and the remaining 29% (2,858 to 4,611 acres) would remain disturbed for the LOP (see Table 2.5). Total surface disturbance at any given time would be limited to a maximum of 14,030 acres. Impact duration would be approximately 76 years plus the time needed for adequate reclamation, or approximately 13 years longer than the No Action Alternative.

The additional Preferred Alternative-specific mitigation and monitoring measures listed for vegetation and wildlife (see Section 2.4.5) would moderate, to some extent, any impacts to BWS species. Impacts still would occur at potentially significant levels for most, if not all BWS species identified as occurring in the JIDPA. Potential indirect impacts to Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker of pumping 1,225 acre-ft of groundwater a year would be offset by payment of a "depletion charge" to the Upper Colorado River Endangered Fish Recovery Program.

4.2.3.8 Cumulative Impacts

The CIAA for TEP&C and BWS species includes the entire range of each species in the BLM PFO area. With regard to federally listed TEP&C species, it is unlikely that any of the alternatives would contribute to cumulative impacts to black-footed ferrets, Ute ladies' tresses, or bald eagles. Neither black-footed ferrets nor Ute ladies' tresses are known to occur on the JIDPA nor are they likely to be affected by the project. Because no bald eagle nests or winter roosts are known to occur within 1 mile of the JIDPA and alternate foraging areas exist within relatively close proximity to the JIDPA, it is unlikely that the project would have any cumulative impact on the bald eagle. The action alternatives may add to cumulative impacts for the four Colorado River endangered fish species as a result of water reductions in the Green and Colorado Rivers; any potential for indirect affect from groundwater pumping for the JIDP would be offset by payment of a "depletion charge" to the Upper Colorado River Endangered Fish Recovery Program.

Project-related impacts to BWS species would add to existing impacts from other disturbances in the CIAA, including existing roads and traffic, oil and gas development, grazing, and other activities resulting in direct mortality, habitat fragmentation, or loss of habitat quality. However, there is no evidence that any of the species would be proposed for listing as threatened or endangered as a result of any cumulative impacts under any of the project alternatives. Site-specific projects requiring surface disturbance on BLM lands require additional permitting which, in turn, may include mitigation measures for BWS similar to those for this project (see Appendices A and B).

4.2.3.9 Unavoidable Adverse Impacts

Habitat loss (direct and indirect) would occur due to construction, and human presence would further reduce habitat quality in some of the remaining undisturbed or minimally disturbed areas. This would result in decreased populations of some BWS species on the JIDPA. Some direct mortality, especially to small mammals, likely would occur during construction and from project-related traffic.

4.2.4 Wild Horses

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (Wyoming State Land Use Commission 1979), and Sublette County (Sublette County Board of Commissioners and Sublette County Planning Commission 2003) identify the following management goals/objectives associated with wild horses:

- to protect, maintain, and control viable, healthy herds of wild horses while retaining their free roaming nature;
- to provide adequate habitat for free-roaming wild horses through management consistent with environmental protection; and
- to provide opportunity for the public to view wild horses.

Impacts to wild horses would be significant if there were a reduction in AUMs of a magnitude that required modification to the management of wild horses in the Little Colorado Herd Management Area (LCHMA) (see Map 3.20), if an action prevented the realization of herd objectives, or if project disturbance resulted in a violation of RMP wild horse objectives.

Although there would be potential impacts to wild horses, it is unlikely that any of the alternatives would result in impacts that would be considered significant in terms of jeopardizing the aforementioned management goals/objectives. There would likely be an increase in wild horse displacement, including movement of wild horses off the RSFO LCHMA onto the PFO portion of the JIDPA (through damaged fences or open gates), resulting in the potential for more injuries as a result of encounters with project facilities (e.g., cattle guards, traffic). Direct impacts would result primarily from vegetation loss. Impacts to wild horse viewing are also anticipated under all alternatives because the quality of views (i.e., views set within an oil and gas development background) would be reduced. The reclamation measures proposed to ensure successful revegetation (see Appendix B) and other practices identified in Appendices A and C would help ensure that none of these impacts are significant.

4.2.4.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect wild horse populations other than those currently approved for the area (BLM 1998b, 2000b). Approximately 16 AUMs would be lost within the LCHMA for the LOP. The duration of impacts would be approximately 63 years based on the proposed rate of development and the time period until affected areas are effectively reclaimed.

4.2.4.2 The Proposed Action

The Proposed Action would result in 2,415 acres of new disturbance (715 acres of LOP disturbance) within the LCHMA, decreasing forage for wild horses in the short term. The extent of forage loss depends on the results of reclamation efforts (see the discussion of effects on livestock grazing in Section 4.5.2). Wild horses would be displaced due to human presence, and the probability of potential vehicle/animal collisions would increase. Impact duration is anticipated to be approximately 76 years (approximately 13 years over the No Action Alternative) plus the time required for effective reclamation.

4.2.4.3 Alternative A

Implementation of Alternative A would result in the same types of impacts as all other action alternatives; however, impacts would be increased in areas that would otherwise have been avoided (e.g., steep slopes, drainage buffers). Impact duration would be the same as for the Proposed Action.

4.2.4.4 Alternative B

Compared to the Proposed Action, loss of forage for wild horses would be lower under Alternative B because this alternative would result in less new disturbance (867 acres) and LOP disturbance (305 acres) within the LCHMA. Wild horses would be displaced due to human presence, and the probability of potential vehicle/animal collisions would increase compared to the No Action Alternative. Impact duration would be approximately 105 years plus the time required for effective reclamation.

4.2.4.5 BLM Preferred Alternative

Impacts under the Preferred Alternative would be similar to those under the Proposed Action, except additional mitigation and monitoring measures would be implemented to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5).

4.2.4.6 Cumulative Impacts

The CIAA for wild horses is the entire LCHMA (see Map 3.20). Existing developments in the LCHMA area are generally limited to secondary roads and natural gas infrastructure. Existing, proposed, and RFD activities are unlikely to reduce the carrying capacity of the Little Colorado Herd Management Unit although shifts in distribution may occur. Undo time expenditure and unnecessary hazing of wild horses back onto the RSFO LCHMA from the PFO portion of the JIDPA may occur due to increased area use for natural gas development and the failure to close field office boundary gates. The primary factor limiting the distribution of wild horses in the LCHMA is the availability of water, which is not anticipated to be affected cumulatively under any alternative, except possibly the Preferred Alternative if new water sources are provided. Cumulative impacts to wild horses are anticipated to be less than significant because wild horse population objectives are currently being met or exceeded in the LCMHA, and the reclamation activities that would be implemented under all alternatives have the potential to provide increased forage for wild horses. The aesthetic values associated with wild horse viewing would continue to decline under all alternatives where horses are observed in areas of development.

4.2.4.7 Unavoidable Adverse Impacts

Other than the temporary short-term and LOP loss of forage, no unavoidable adverse impacts to wild horses are anticipated.

4.3 CULTURAL AND HISTORICAL RESOURCES

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) prescribe the following management goals/objectives associated with cultural resources:

- to design cultural resource management actions to maintain the value of cultural resources;
- to expand the opportunities for scientific study and educational and interpretive uses of cultural resources;
- to protect and preserve important cultural resources or their historic record for future

generations; and

- to resolve conflicts between cultural resources and other resource uses; and conserve and develop historic resources for the benefit of present and future generations.

Because of the requirement for compliance with Section 106 of the NHPA and with the ARPA on federal lands, all areas on federal lands (surface or mineral estate) proposed for surface disturbance would be surveyed for cultural resources. These inventories would serve to further cultural heritage by protecting most cultural properties from significant damage, increasing cultural resource site databases, and furthering the understanding of history and prehistory. Impacts to historic and cultural resources would be considered significant if they resulted in non-mitigated impacts to National Register-eligible properties, diminishment of the aspects of site integrity, loss of scientifically important data or artifacts, a violation of the NHPA and/or ARPA, or disturbed Native American sensitive sites, or if they were inconsistent with the goals/objectives listed above. Application of various mitigation protocol (see Appendices A and C) would reduce impacts to cultural resources under all alternatives; however, in the absence of a Programmatic Agreement and Cultural Resource Management Plan, potential significant impacts to cultural resources could occur under any alternative.

The greatest identifiable threats to cultural resources result from increased ground disturbance. Overall impacts to cultural resources would primarily occur in direct proportion to the volume of new surface disturbance. More acres of disturbance would generally make cultural property avoidance more difficult, would increase the need for cultural site mitigation, and would result in more discoveries, excavation, chances for illegal artifact collection and/or vandalism, and/or impacts to sites, locales, and places considered sacred, sensitive, or of importance to modern-day Native Americans, such as the Shoshone People. Vandalism and illegal collection impacts would occur in relative proportion to the amount of human use on the area.

Because of the requirement for cultural resource inventories in new disturbance areas, a large number of cultural properties would also be found and added to the cultural resource database under all development alternatives. In addition, a large number of site mitigations (e.g., excavations) would be likely to occur, as avoidance of some NRHP-eligible sites likely would not be possible. Data recovery excavations would serve to increase the understanding of the culture history of the region. However, this would not be true for cultural resources on State of Wyoming lands. Procedures for identifying and protecting cultural resources on State of Wyoming lands are not in place. Generally, BLM requires inventory on State of Wyoming lands as a connected action for the first access; however, once federal access via a ROW or other federal permit to these lands is obtained, uninventoried future construction and project developments and associated unmitigated site disturbance may occur. Only with the implementation of a cooperative State of Wyoming land development protocol for addressing cultural resources, such as might be established through a Programmatic Agreement, could the avoidance of significant adverse impacts to cultural resources on state lands be assured.

While avoidance of NRHP eligible sites would likely remain the primary tool to minimize potential adverse effects to cultural resources, a high degree of new development is proposed for the JIDPA, with much of this development likely to occur in geomorphologically sensitive areas with high archaeological site discovery potential, and project-by-project avoidance would prove to be increasingly difficult and time-consuming. Because new ground disturbance is proposed within the JIDPA under all development alternatives, it would not only be much more difficult to avoid identified cultural resources, but numbers of unanticipated archaeological discoveries would also increase. Such unexpected discoveries are currently being handled on a case-by-case basis under the general direction of 36 CFR 800.13. Consultation involves the Operators, BLM, Wyoming SHPO, and other interested parties. Under all project development alternatives, a greater number of construction projects would be delayed due to cultural resource discoveries and subsequent consultation requirements. Because of the frequently complex nature of such discoveries, the need for development of case-by-case treatment plans, the exposed nature of the resource discovered, and the availability of archaeologists to evaluate the discovery, delays are common. Implementation of Programmatic Agreements and treatment or discovery plans that identify standard treatments, procedures, and management alternatives would lessen the impacts unexpected discoveries have on specific development projects. Duplication of paperwork is reduced, timeframes for decision-making are greatly condensed, more “hands-on” management of an already damaged resource can occur, and overall management efficiencies are increased. A reduction in delay to Operators also results in a savings in construction costs and lessened shutdown impediments. Development and implementation of these plans would be beneficial to all parties, given the substantial increase in proposed ground disturbance within culturally sensitive areas. Programmatic approaches in the JIDPA could also benefit data synthesis and provide useful information to scholars and the general public.

Overall, impacts to cultural resources not identified during surveys for cultural resources, such as arising from an archaeological discovery situation (cultural materials found during and not prior to surface-disturbing activities), could be greater and more significant than impacts to resources that were previously identified. This is because damage to discovery sites would occur prior to the site being either recorded or evaluated, thereby complicating cultural resource mitigation procedures. The most significant and time-consuming mitigation of archaeological discoveries would likely be when subsurface components containing extensive or abundant artifact assemblages are located during large disturbances and for sites with structural or human remains in San Arcacio soil contexts, as occur along Sand Draw. Mitigation of impacts to archaeological discovery sites could often be accomplished through data recovery excavations, which would increase our understanding of prehistory to varying degrees, depending on the nature and extent of the discovery. Significant impacts can occur in situations where undocumented NRHP-eligible archaeological sites are impacted but not recognized (and therefore not treated as discoveries and not appropriately mitigated).

Subsurface prehistoric site discoveries resulting from construction are common in portions of the JIDPA, and more of these discoveries are likely to occur with continued development. Archaeological discoveries most often occur on the toes of small but discreet upland hillocks and rises flanked by intermittent drainages and on the terraces and valley slopes adjacent to Sand Draw. Sediments along Sand Draw are particularly sensitive; these are primarily San Arcacio soils known to contain intact Archaic period sites, including those with housepits. These soils extend as much as 0.5 mile from each side of the drainage channel. Impacts to cultural resources discovered during construction activities would be minimized by moving further proposed surface disturbances or through appropriate mitigation. Any cultural resources discovered during project construction would be treated in accordance with 36 CFR 800 and the statewide protocol.

Adverse impacts to other NRHP-eligible properties, especially properties considered important to Native American groups, would be significant under all alternatives if they cannot be satisfactorily mitigated as determined through consultation with SHPO and other interested parties. Previous consultation with Native American Tribes has determined that the 48SU4000 Archaeological District is sensitive to Native Americans, as are several rock alignment sites along the edge of Yellow Point Ridge. Any increase in ground-disturbing activities has an increased potential of impacting significant sites, locales, and places considered sacred, sensitive, or of importance to modern-day Native Americans, such as the Shoshone People in particular.

The Site 48SU4000 complex is highly sensitive and currently at risk. Extant and potential field developments pose a risk of direct threats to the site complex, and these threats would continue as the number of individuals familiar with and accessing the area increases due to ancillary adverse effects resulting from vandalism. To begin addressing these issues, the BLM and one of the Operators have negotiated a long-term site monitoring plan that includes a detailed inventory and recording of the entire District, as well as photographic monitoring and evaluation of looting. Miner (2001) has recommended pre-emptive mitigative excavations of rockshelters in highly visible locations and at significant locations in the vicinity of any proposed well pads and related facilities. Area-specific plans and procedures would continue to be promulgated and implemented to protect the resources in this area.

Overall, vandalism to cultural properties and illegal artifact collection would continue to be an issue in the JIDPA under all alternatives. Construction of new roads for well field expansion would provide access to additional areas, increasing the potential for vandalism. The increase in development under all development alternatives would increase traffic and human presence in the area, leading to additional artifact collecting and "pot hunting." Potential impacts associated with vandalism and illegal artifact collection are assumed to be directly proportional to the level of human activity (i.e., with a higher human presence there would be increased impact potential). Therefore, these potential impacts would likely be greatest during the development period, but would continue for the LOP. For the JIDPA overall, vandalism may be minimized through law enforcement, site monitoring activities, and educational programs.

4.3.1 No Action Alternative

Under the No Action Alternative, there would be no additional surface disturbance other than that already approved by the BLM (1998b, 2000b). Prior NEPA documents concluded that there would be no significant adverse impacts to cultural resources as a result of the project; however, these conclusions assumed implementation of a Programmatic Agreement among BLM, SHPO, and Operators. Since expiration of the Programmatic Agreement ratified in 1998, significant impacts have occurred and, while most cultural resource impacts have already occurred and been largely mitigated, potentially significant impacts could still occur. Few new cultural resource inventories would be conducted, and no new sites would be recorded and added to the cultural resource database. Vandalism and illegal artifact collecting may continue for the LOP. In the absence of new ground disturbance, no additional unanticipated discoveries are likely to occur. Cultural resource impacts would continue for an estimated 63 years under the No Action Alternative. No new impacts to Native American religious or culturally significant sites are anticipated beyond current levels.

4.3.2 The Proposed Action

Under the Proposed Action, an estimated 20,126 acres (66% of the JIDPA) would be directly impacted by surface-disturbing activities, and an additional 283 acres of disturbance would occur at locations outside the JIDPA (e.g., Burma Road upgrade, compressor stations). This equates to a total disturbance of 20,409 acres and an average disturbance of 429 acres per 640-acre section. Impacts to cultural resources would be increased due primarily to new surface disturbance (16,200 acres). Vandalism and illegal artifact collection would likely be greatest during development (approximately 13 years), but would continue for approximately 76 years and until project personnel are no longer required for the LOP.

4.3.3 Alternative A

Under Alternative A, impacts to cultural resources would be increased from those of the No Action Alternative, be the same as those of the Proposed Action, but be increased in areas such as Sand Draw that would be avoided under other alternatives. Vandalism and illegal artifact collection would likely be greatest during development (approximately 13 years), but the duration of these impacts would continue for the LOP (approximately 76 years).

4.3.4 Alternative B

Under Alternative B, approximately 7,223 acres of the JIDPA would be directly impacted by surface-disturbing activities, and an additional 208 acres of disturbance would occur at locations outside the JIDPA (e.g., , compressor stations). This would result in an increase to potential impacts to cultural resources from that of the No Action Alternative. Cultural property avoidance may be more difficult under Alternative B as compared with the other development alternatives (i.e., existing pads would be increased in size) because pad locations are fixed. Vandalism and artifact collection would likely be greatest during development (approximately 42 years), but duration of these impacts would continue for the LOP (approximately 105 years).

4.3.5 BLM Preferred Alternative

Under the Preferred Alternative, approximately 13,822–20,126 acres of the JIDPA (45.3–66.0%) would be directly impacted by surface-disturbing activities, and an additional 208 acres of disturbance would occur outside the JIDPA. An average disturbance of 290–423 acres per 640-acre section would occur in the JIDPA. Impacts to cultural resources would be increased from that of the No Action Alternative due primarily to new surface disturbance (5,612–11,916 acres more than No Action). Vandalism and illegal artifact collection would likely be greatest during the development period (approximately 13 years) but would continue for the LOP (approximately 76 years).

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5). Any measure that reduces the volume of surface disturbance or the level of human presence has the potential to reduce impacts to cultural resources.

4.3.6 Cumulative Impacts

Cumulative impacts to cultural resources within their CIAA (see Map 3.5) would include those detailed in past NEPA documents (BLM 1997a, 1998a, 2000a) and would generally be as described for this project, but would occur over the larger CIAA and as a result of additional non-project-related ground-disturbing and vandalism/illegal collection activities primarily associated with energy developments in the Pinedale Anticline area. Additional direct impacts to cultural resources in the CIAA and outside the JIDPA have resulted primarily from development of the Pinedale Anticline Gas Field to the north of the JIDPA. With the implementation of the cultural resource mitigation actions identified in Appendices A and C, cumulative impacts to cultural resources in the JIDPA would be minimized or offset.

The great increase in the human presence in the JIDPA and surrounding areas since 1997 has tremendously increased vandalism and artifact collection (Vlcek pers. comm.). Numerous contacts among regulatory agency personnel and consultants have noted considerable illegal artifact collection in the area. The cumulative effect of this activity has been adverse. Illegal artifact removal has made the evaluation of surficial archaeological sites quite difficult due to the absence of diagnostic artifacts, tools (which aid in the determination of site function), and the resultant alteration of site context and setting.

Unmitigated loss of cultural resources in discovery and undocumented site situations associated with ground-disturbing actions would accumulate. Inventory, recordation, and data recovery projects triggered by ground-disturbing actions would continue to increase the cultural resource database, likely improving future cultural resource management decisions. Generally, the greater the increase in permitted activity, the greater the data acquisition of cultural resource information will be. In 2004 alone, several major new archaeological discoveries were made and documented, greatly increasing our knowledge of the prehistory of the area. The recovery of a 7,300-year-old human burial is one such example and the data recovery efforts at Site 48SU4479 are beginning to tremendously expand knowledge of the prehistory of the Upper Green River Basin. Cumulatively, archaeological investigations in the JIDPA have made notable positive impacts upon our knowledge of the archeology of the region.

Data recovery excavations remove all or a portion of in situ cultural materials at sites, thereby resulting in potential future data loss if new data recovery and analysis techniques are developed. These impacts would accumulate as additional sites are excavated.

Increased surface-disturbing activities and human presence primarily resulting from expanded energy development activities in the CIAA would result in increased cumulative adverse effects, and because many of these impacts are indirect (illegal artifact collecting or digging), they are difficult to minimize or mitigate. Under any project development alternative, cumulative impacts would increase with increased surface disturbance and human activity, and significant cumulative effects to cultural resources could occur if undocumented and unrecognized NRHP-eligible sites are impacted and unmitigated.

4.3.7 Unavoidable Adverse Impacts

Because of the requirement for compliance with Section 106 of the NHPA and with the ARPA on federal lands, adverse impacts are generally avoided or mitigated with the exception of situations where undocumented NRHP-eligible sites are impacted but not recognized, thereby occurring without mitigation. This type of unavoidable adverse impact may occur under all alternatives.

Unmitigated adverse effects to eligible sites could also occur on State of Wyoming lands because fewer protections are afforded to cultural resources on lands falling outside BLM jurisdiction. Unexpected discoveries on state lands have occurred, and procedures for mitigative treatment of these finds are not in place. Therefore, unavoidable adverse impacts to discovery sites would continue until or unless formal procedures for protecting cultural resources on State of Wyoming lands are implemented.

4.4 SOCIOECONOMICS

The PFO and RSFO RMP RODs (BLM 1988b, 1997b, 2004b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with socioeconomics:

- to coordinate land use decisions with economic factors and needs;

- to mitigate economic, social, and environmental impacts on communities caused by rapid or large-scale growth and development;

- to plan for the provision of public facilities and services, including safe and efficient transportation and utility systems, in coordination with local land use policies, goals, and objectives; and

- to provide adequate, suitable land to meet housing needs of all residents.

BLM (1999) criteria stipulate that impacts to socioeconomic resources would be considered potentially significant if any of the following were to occur:

- increased demand for housing resulting from project activities that exceeds supply;

- short- or long-term increases in demand for local government facilities or services that exceed existing capacity and are not offset by adequate revenues from continued exploration and development; or

- a 10% change in county government or in countywide employment.

The SCBC and SCPC (2003) emphasize the following values specific to the social traditions and socioeconomic base of Sublette County:

- Sublette County's unique local culture should be preserved and enriched, a culture characterized by a rural Wyoming flavor, a thriving private business community, an atmosphere friendly to working families, and the security of friendly crime-free communities.

- There should be an abundance of economic freedom and diverse opportunities for residents old and new to pursue prosperity and happiness—complemented and sustained by a business-friendly atmosphere, reasonable taxation, a low cost of living, limited regulation, wise development of its natural resources, and a strong work ethic.

Unless otherwise cited, the socioeconomic information that follows has been summarized from the *Socioeconomic Analysis Technical Support Document for the Jonah Infill Drilling Environmental Impact Statement* (BLM 2005), which is available from the BLM PFO. Please refer to that document for more detailed socioeconomic information and analysis. Additional information has been taken from the socioeconomic profile (BLM 2003b) prepared for inclusion in the Pinedale RMP.

BLM defines a significant change as any change that would result in a 10% or greater change of any affected factor. The following analyses show that the project under all alternatives is compatible with BLM management objectives. Socioeconomic impacts are anticipated as a result of increased local taxes and revenues. Under the No Action Alternative, the affects of increased employment, economic activity, and substantial federal, state, local, and county revenues would not occur; therefore, this alternative would not be in accord with BLM, state, and local land use plans. Cumulative impacts are likely to have some economic and social consequences in the CIAA.

In the long term, all alternatives would likely result in economic impacts. Population figures are not likely to be substantially affected over the LOP, with the possible exception that there may be short-term (development phase) population impacts as a result of cumulative impacts from in-migration associated with this project in combination with other regional projects (e.g., Pinedale Anticline).

Depending upon the number of wells developed per year, project construction, drilling, completion, and production, from approximately 63 to 105 years would be required to complete the project. The fewer the number of wells and/or the faster the pace of development, the shorter the LOP. Production for the LOP could range from 3,366 billion cubic feet (BCF) under the No Action Alternative (no new development) to 8,191 BCF under the Alternative A (3,100 new wells and new well pads).

The economic impact of the Proposed Action, alternatives, and cumulative actions on the study-area economy were analyzed in two phases using the methods developed for the SWREE (UWAED 1997) and JMHCAP (UWAED 2003, BLM 2003a). Phase I was the development phase, which considered the economic impacts associated with drilling and completion of infill wells. Due to the large price fluctuations in natural gas, the economic impacts of production were estimated based on cost of production rather than total output. Phase II considered the economic impact of natural gas and condensate production as a result of the production from the wells completed under Phase I.

Assumptions and Methods

Assumptions and methods are detailed in the socioeconomic technical support document (BLM 2005). Economic impacts are presented in terms of real and nominal impact. A real discount rate has been used to adjust and to eliminate the effect of expected inflation to determined discounted constant-dollar (present value or “real value”) of benefits and costs. Pursuant to OMB Circular No. A-94, the real discount factor is calculated as $1/(1+i)^t$ where i is the interest rate and t is the project year (OMB 2004). The present value is the value of those activities after the real discount rate has been applied over time. As presented herein, the nominal value of project activities is the simple calculation of dollars with no adjustments. Natural gas economic activity will depend upon three primary factors: 1) total number of wells authorized, 2) total number of pads on which wells can be placed, and 3) rate of development. Total recovery will depend upon the number of wells and the number of pads they are placed on. The fewer the number of wells and the faster the pace of development, the shorter the LOP. Some combinations of conventional/directional drilling may make full recovery uneconomical. An estimated 12,800 BCF of natural gas and 99.8 million barrels of Jonah Field condensate (oil) are present beneath the JIDPA. No alternative anticipates total recovery of all natural gas or condensate resources present in the field. Total annual per well operation cost is presented in Table 4.16.

Table 4.16. Annual Cost of Natural Gas Production, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006[1]

Annual Production Operating Costs	Annual Cost per Well
Annual Production (thousand cubic feet [MCF])	717,232
Direct Labor and Overhead	$16,831
Nonlabor Annual Costs	
Fuel, Chemicals, and Disposal	9,850
Surface Maintenance	5,847
Subsurface Maintenance	5,979
Electricity	–
Gas Compression Costs	–
Gas Transportation Costs	191,041
Nonlabor Annual Costs	$212,717
Total Annual Costs	$229,548
Total Annual Cost Per MCF	$0.32
Nonlabor Cost Per MCF	$0.30

[1] Source: Operators. Assumes natural gas recovery costs include recovery of condensate.

Labor

An estimated 16,863 worker-years of direct employment would be provided by the Proposed Action during the LOP (see Appendix B). Jobs indirectly created or induced as a result of development and operations are presented in terms of annual job equivalents (AJEs). An AJE represents 12 months of employment. For example, one AJE could represent one job for 12 months or two jobs for 6 months or three jobs for 4 months. For the purposes of this analysis, a job is defined as 260 worker-days or 1 worker year, and a person-year is 365 days; therefore, there are approximately 1.4 worker years per person year. An AJE would not necessarily result in a new job; it may simply represent the continuation of an existing job that would otherwise have been terminated had the development not occurred. Average annual starting wages per job would not necessarily be the earnings for each job created/maintained. Actual wages are determined on an individual basis by employers as influenced by market forces.

Economic Activity from Development and Production

An in-depth discussion of expected economic activity is presented in BLM (2005). A summary of expected economic activity from one conventional and one directionally drilled well is presented in Table 4.17. AJEs represent secondary jobs and do not include project-related jobs listed in Table 2.2 of Appendix B. Expenditures made to drill and complete one conventional well would generate economic activity (direct and secondary) of $2,719,091 and would generate 16.7 AJEs. Expenditures made to drill and complete one directionally drilled well would generate economic activity (direct and secondary) of $3,051,586 (includes $621,292 of secondary labor earnings) and would generate 19.4 AJEs. This activity is assumed to remain constant across all alternatives on a per-well basis. The timing of economic activity will depend on the approved number of wells and the rate of development.

Table 4.17. Economic Activity from Gas Drilling Per Well, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Estimated Impacts	Conventional Well	Directionally Drilled Well
Direct Expenditures[1,2]		
Drilling ($)	$653,574	$897,184
Completion ($)	$1,533,110	$1,533,110
Total Direct Expenditures ($)	$2,186,684	$2,430,294
Secondary Labor Earning		
Drilling ($)	$239,402	$328,287
Completion ($)	$293,005	$293,005
Total Secondary Labor Earnings ($)	$532,407	$621,292
Total Economic Activity Impact per Well	$2,719,091	$3,051,586
Annual Job Equivalents (AJEs)		
Drilling	7.3	3.3
Completion	9.4	1.2
Total AJEs per Well[3]	16.7	19.4
Average Earnings per Created Job ($)[4]	$31,881	$32,025

1 Includes proposed labor costs.
2 Completion includes the cost of completion and setting of production equipment.
3 AJEs are jobs indirectly created as a result of the activity. They do not include the direct labor jobs (proposed) presented in Appendix B.
4 This estimated average annual starting wage per job would not necessarily be the actual wage paid for each created job. Actual wages are determined on an individual basis by employers as influenced by market forces.

The value of natural gas production is based on revenues less cost of operation. Table 4.18 shows that production from one BCF of natural gas would generate total economic activity (direct and secondary) of $3,632,083 (includes $132,083 of secondary labor earnings) and would create 3.92 AJEs. One MBO is assumed to generate total economic activity (direct and secondary) of $21,792,498 (includes $792,498 of secondary labor earnings) and would create 23.52 AJEs. The economic activity associated with condensate production is likely conservatively underestimated because condensate from the Jonah Field is of particularly high quality and generally sells for a price higher than the price of crude oil. Assumed production rates, decline curves, and discounting tables are presented in the socioeconomic technical support document (BLM 2005: Appendix A).

Table 4.18. Economic Activity Gas Production from One BCF of Natural Gas and One MBO, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Resource	Economic Activity
Natural Gas	**Activity per BCF**
Revenue[1]	$3,500,000
Secondary Labor Earnings	$132,083
Total Economic Activities	$3,632,083
AJEs	3.92
Condensate	Activity per Million Barrels
Revenue[2]	$21,000,000
Secondary Labor Earnings	$792,498
Total Economic Activities	$21,792,498
AJEs	23.52

1 Price is $3.50/MCF based on CREG (2004). The value of production is based on revenues less cost of operation.
2 Price is $21/bbl based on CREG (2004). Assumes natural gas recovery costs

Government Revenues

Under all alternatives (including No Action), the project would generate substantial revenues for state, county, and local governments, as well as area school districts, through state sales tax, federal income tax, ad valorem taxes, severance taxes, federal minerals royalties, and other taxes on facilities and production. Assumptions regarding the analysis of project effects on government revenues are detailed in the socioeconomic technical support document (BLM 2005).

The estimated revenues and taxes resulting from the project, as well as their present value, for the LOP are presented in detail in the socio-economic technical support document (BLM 2005), including the likely distribution of those funds to the U.S., Wyoming, and affected counties, cities, and towns based on current statutes and distribution trends. For the purposes of this analysis, the rate of development and an average decline curve for individual well production (BLM 2005: Appendix A) was used to estimate total annual field production; well life was assumed to be 40 years. Increases in taxes and revenues would have the effect of providing counties and communities with more discretionary dollars to develop infrastructure and provide for the needs of low-income residents; thus, the dependence on federal or state grant monies would be reduced.

All counties in the study area would benefit from increased revenues from federal royalties, severance taxes, sales taxes, and presumably use and lodging taxes, although the latter are not discussed further.

Because development and production would occur within Sublette County, directly related increases in ad valorem production and property taxes would impact only Sublette County and its communities. Ad valorem taxes on production were estimated for this analysis; however, real property values are likely to change if population fluctuates due to cumulative non-project-related factors, which could result in fluctuating receipts from ad valorem taxes on property. Real property value changes are beyond the scope of this analysis and are not addressed further.

Recreation

Economic losses could result if recreationists were displaced from the JIDPA and moved their activities out of the study area. Losses would be proportional to the number of displaced recreationists. For the purposes of this analysis, it is assumed that all recreation would be lost from the JIDPA for the LOP. (It is also likely that most of this loss has already occurred due to existing development effects.)

Direct impacts from displaced non-consumptive recreationists (per visitor day) could result in a loss of $29.62 (including $6.80 of labor income) and 0.000518 AJEs each (Table 4.19). If all 3,396 RVDs (see Section 3.4.10) were lost (regardless of the alternative), there would be a loss of direct expenditures of $100,590 (including $23,093 labor earnings) and a loss of 1.8 AJEs annually for the LOP (BLM 2005).

Table 4.19. Economic Activity per RVD from Nonconsumptive Recreation, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Item	Economic Activity per RVD
Direct Expenditures	$22.82
Secondary Labor Earnings	$6.80
Total Economic Activity per RVD	$29.62
AJES per RVD	0.000518

It is likely that most recreationists who would avoid the JIDPA as a result of natural gas development would relocate their activities to other places in the vicinity that provide similar recreational opportunities. Individuals may experience impacts in terms of lessened enjoyment and satisfaction from relocated recreational activities.

Economic activity from hunting could be reduced if hunters were displaced from the JIDPA and moved their activities out of the study area. Losses would be proportional to the number of displaced hunters. Under the Proposed Action and alternatives, populations of pronghorn antelope and/or greater sage-grouse, which are the two principal species hunted on the JIDPA, would likely be displaced to such an extent that recreational hunting on the JIDPA may no longer occur. Cottontail rabbits are also hunted on the JIDPA, but are unlikely to be displaced by project activities. However, it is likely that hunters already avoid the area due to existing development. Lands adjacent to the JIDPA may absorb displaced hunting pressure because displaced wildlife (most notably pronghorn antelope and greater sage-grouse) may also move to adjacent lands; thus, no economic loss may result from loss of hunting due to the project. However, for the purposes of this economic analysis, it is conservatively assumed that all hunting on the JIDPA would be lost for the LOP.

Only pronghorn antelope, cottontail, and greater sage-grouse are likely to be hunted on the JIDPA. WGFD does not collect resident versus nonresident information for cottontail and greater sage-grouse hunting; therefore, it will be conservatively assumed for the purposes of this analysis that all hunters are nonresident. Direct impacts from displaced pronghorn hunters (61.0 hunter days per year attributable to JIDPA) could result in a loss of $536.46/hunter day (including $155.16 of labor income) and 0.012087 AJEs each (Table 4.20). Direct impacts from displaced cottontail hunters (26.4 hunter days per year) could result in a loss of $243.48/hunter day (including $70.42 of labor income) and 0.005486 AJEs each. Direct impacts from displaced greater sage-grouse hunters (16.3 hunter days per year) could result in a loss of $183.32 (including $53.02 of labor income) and 0.004131 AJEs each. If all hunters relocate their activities away from the JIDPA could result in a loss of $42,140 ($12,188 of labor income) and 0.95 AJEs of annual economic activity (BLM 2005).

Table 4.20. Economic Activity per Hunter Day, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Item	Economic Activity per Hunter Day			
	Pronghorn	Cottontail	Greater Sage-grouse	Total
Direct Expenditures	$381.30	$173.06	$130.30	$684.66
Secondary Labor Earnings	$155.16	$70.42	$53.02	$278.60
Total Secondary Activity per Hunter Day	$536.46	$243.48	$183.32	$963.26
AJEs per Hunter Day	0.012087	0.005486	0.004131	0.021704

It is likely that any hunters discouraged from engaging in activities in the JIDPA as a result of natural gas development would relocate their activities to other locations in the vicinity.

Social Impacts

Social impacts are discussed in more detail in the socioeconomic technical support document (BLM 2005).

The project could result in some increases in population in Sublette, Lincoln, and Sweetwater Counties as a result of job seekers from other areas moving to the area in search of employment, although existing industry expertise and services in the three counties is generally adequate to service additional oil and gas development. With an estimated 1,713 available workers in the study area and 12,000 available workers in Wyoming, the estimated number of laborers that would be directly employed as a result of the project would be readily available. However, some in-migration of labor is anticipated as a result of the project; without adequate planning at the local level, increases in population would likely have some effect on communities in the study area.

The project would directly provide up to 9,899 worker years and up to 52,930 AJEs during development and up to 6,964 new worker years and 32,823 new AJEs during production. The duration of these impacts, and therefore the number of jobs, would depend on the rate of development. Some of these jobs would be existing jobs that would continue to occur as a result of continued development and operations that would otherwise have been lost; some jobs would be newly created parallel or transitional jobs. These jobs would likely reduce or prevent an increase in unemployment in the study area and the state. The projects would result in beneficial impacts to local employment—both to the workforce directly involved in oil and gas development and to the general service economy—especially during construction and drilling.

The average wage in the study area ranged from $25,050 to $33,478 in 2000 (see Table 3.34). The estimated annual starting wage per job for jobs created indirectly from development on the JIDPA would range from $31,881 to $32,025. The estimated annual starting wage per job from JIDP production would be $47,173. These estimated annual starting wages are higher than the average wages reported in 2000. Thus, there would likely be beneficial impacts on income and poverty reduction as a result of the Proposed Action and action alternatives. These benefits would not be realized under the No Action Alternative.

Quality of life could cumulatively be impacted by oil and gas development and production in the area. Potential beneficial effects include increased local economic activity and reduced poverty, more health care providers, and improved schools and other tax-supported services and amenities (e.g., libraries, streets, parks). Increased economic activity could enhance the availability of goods, services, and cultural, educational, and certain recreational opportunities. However, some individuals would likely perceive a reduction in the quality of life in the area. The increasing conversion of large tracts of land to gas development is seen by some as industrialization and a diminishment of the characteristics they most value in the region: its natural beauty and quiet, vast reaches of unpopulated and undeveloped open space, fresh air, and wildlife. Moreover, as previously mentioned, the population in the study area is not anticipated to substantially increase in the long term as a result of this project. Because of the demographics of the laborers attracted to oil and gas development and production coupled with a record of increasing criminal activity already affecting the CIAA, the project will likely exacerbate an already worsening crime rate (see Jeffrey Jacquets December 2005 report entitled “Index Crimes, Arrests, and Incidents in Sublette County 1995 to 2004 Trends and Forecasts”).

Depending on how many oil and gas employees relocated to the area, there is a possibility of higher per capita income in the study area. This could attract additional healthcare providers to the area or encourage existing healthcare providers to remain in the area. However, impacts already being experienced by the healthcare community may be incrementally increased as a result of potential increases in population from oil and gas employees attracted by jobs and the secondary employment expected to be generated by the project.

Population in the study area may increase as a result of increased employment opportunities generated both directly and indirectly by the JIDP, affecting the availability of housing. To illustrate the point, both Sublette and Sweetwater Counties are facing a housing shortage and any additional pressure would exacerbate an already tight housing market (Saxton 2005, Gearino 2005). Housing in LaBarge, Lincoln County, is considered available but limited (Woodward

2005). Moreover, if population were to increase, the increased demand for housing would likely put even more upward pressure on already high housing prices (rental costs and home sales prices). Additionally, increased affluence in the study area is likely to cause an increase in the demand for higher-quality housing, which could result in increased housing construction projects. This could make it more difficult for some individuals to obtain satisfactory housing within affordable price ranges.

Increased cost of living and inflation already being experienced by the affected communities also may be incrementally increased by the project.

Increased revenues to schools as a result of increased ad valorem and other taxes and revenues would be a beneficial impact to the school systems, thereby allowing for a higher quality teaching environment and potentially increasing the wages of teachers, which could attract teachers with better credentials than would otherwise seek positions within the study area. Any increases in population would likely aid in offsetting the current trend toward school closures/consolidations in some communities. Additionally, increased funding would provide schools with more options to improve education and raise performance test scores, thus increasing the overall education level and improving the overall quality of the workforce in the study area. Increases in population may help reduce impacts already being experienced by schools in affected communities that have resulted in school closures.

4.4.1 No Action Alternative

Under the No Action Alternative, no additional well field development would occur; thus, no economic activity from development would occur (Table 4.21). Production would be limited to the life of currently producing wells; therefore, only up to 3,366 BCF of gas and 31.98 MBO would be recovered under this alternative.

Over the LOP, the No Action Alternative would generate up to $11,029.4 million present value, including $1,753.7 million present value in taxes/royalties. Nominal taxes and royalties to Sublette County would be $741.92 million. Based on a population of 6,654 (Year 2004), this would be equivalent to the county receiving $111,484 (approximately $2,787 annually) for each person in the county.

The No Action Alternative would create the least number of AJEs (13,947) (see Table 4.21) and no changes in population.

No effect would be expected to occur on the economic value of recreation or hunting.

In summary, under the No Action Alternative, the least amount of change in economic activity from current conditions would be expected when compared to all other alternatives. No additional secondary labor earnings or jobs would be created, and no additional taxes or revenues from development would be realized. This would reduce the number of drilling rigs, crews, and associated services currently operating in the area. Between 1996 and 2002, approximately 59.3% of all exploration and production oilfield service fees paid in the state were spent on services in the Jonah Field (Schlumberger Oil Field Services Companies 2003). These services and associated jobs would likely be reduced or eliminated under the No Action Alternative.

Table 4.21. Summary of Total Economic Activity Resulting from Natural Gas Development and Production over the Life of Field, Jonah Infill Drilling Project, Sublette County, 2006

Economic Effect	Economic Activity Resulting from Development (LOP)				
	No Action	Proposed Action	Alternative A (Maximum Development)	Alternative B (Minimum Recovery)	Preferred Alternative
Total Anticipated Natural Gas Recovery over the LOP (BCF)	3,366	7,947	8,191	6,124	7,947
Total Anticipated Condensate Recovery over the LOP (million bbls)	31.98	75.50	77.81	58.18	75.50
Potential Change in Employment					
Secondary Development Employment (AJEs)	--	52,930	52,187.5	61,110	52,930
Average Earnings Per Job	--	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025	$31,881 to $32,025
Secondary Production Employment (AJEs)	13,947	32,928	33,939	25,374	32,928
Average Earnings Per Job	$47,173	$47,173	$47,173	$47,173	$47,173
Recreation AJEs	--	-92.4	-92.4	-144.2	-92.4
Hunting AJEs	--	-49.9	-49.9	-77.9	-49.9
Potential Change in Employment (AJEs)	13,947	85,715.7	85,984.2	86,261.9	85,715.7
NOMINAL VALUE OF ECONOMIC ACTIVITY					
75 Wells Per Year Development Rate					
Value of Development[1] (millions of $)	0.0	--	--	9,612.5	--
Value of Production[1,2] (millions of $)	12,922.5	--	--	23,510.8	--
Taxes/royalties from proposed project (millions of $)	2,334.9	--	--	4,881.4	--
Recreation (millions of $)	0.0	--	--	-8.2	--
Hunting (millions of $)	0.0	--	--	-3.5	--
Total Nominal Economic Activity (millions of $)	15,257.4	--	--	37,993.0	--
250 Wells Per Year Development Rate					
Value of Development[1] (millions of $)	0.0	8,588.6	8,497.2	--	8,588.6
Value of Production[1,2] (millions of $)	12,922.5	30,509.5	31,446.1	--	30,509.5
Taxes/royalties (millions of $)	2,334.9	6,072.1	6,234.7	--	6,072.1
Recreation (millions of $)	0.0	-5.3	-5.3	--	-5.3
Hunting (millions of $)	0.0	-2.2	-2.2	--	-2.2
Total Nominal Economic Activity (millions of $)	15,257.4	45,162.7	46,170.5	--	45,162.7
PRESENT VALUE OF ECONOMIC ACTIVITY[3]					
75 Wells Per Year Development Rate					
Value of Development[2] (millions of $)	0.0	--	--	4,997.3	--
Value of Production[2] (millions of $)	9,275.7	--	--	9,325.1	--
Taxes/royalties (millions of $)	1,753.7	--	--	2,108.2	--
Recreation (millions of $)	0.0	--	--	-2.7	--
Hunting (millions of $)	0.0	--	--	-1.1	--
Total Present Value of Economic Activity (millions of $)	11,029.4	--	--	16,426.8	--
250 Wells Per Year Development Rate					
Value of Development[2] (millions of $)	0.0	6,631.8	6,561.2	--	6,631.8
Value of Production[2] (millions of $)	9,275.7	17,963.8	18,511.2	--	17,963.8
Taxes/royalties (millions of $)	1,753.7	3,474.7	3,574.9	--	3,474.7
Recreation (millions of $)	0.0	-2.4	-2.4	--	-2.4
Hunting (millions of $)	0.0	-1.0	-1.0	--	-1.0
Total Present Value of Economic Activity (millions of $)	11,029.4	28,066.9	28,643.9	--	28,066.9

[1] Includes non-project labor earnings resulting from secondary economic activity induced by project activities. These earnings do not include project labor earnings.
[2] Natural gas plus condensate; Proposed Action and the other action alternatives wells currently in production (i.e., No Action Alternative wells); natural gas price is assumed at $3.50/mcf and condensate price is assumed at $21/bbl.
[3] Number of years to develop is approximately 42 years for Alternative B and13 years for all other action alternatives; well life is assumed to be 40 years; see Section 4.4 for a discussion of discounting. The discount rate used for this analysis was 3.5%. Conservatively assumes revenues are received as a lump.

4.4.2 Proposed Action

Because up to 3,100 new wells (assumed at 2,825 conventional, 275 directional) would be drilled under the Proposed Action, economic activity from development would be greater than under the No Action Alternative (see Table 4.21). Up to 7,947 BCF of gas and 75.5 MBO would be recovered under this alternative.

Over the LOP, economic activity would be $28,066.9 million present value, including $3,474.7 million present value in taxes/royalties (see Table 4.21). Nominal taxes and royalties to Sublette County would be $1,839.08 million. Based on a population of 6,654 (Year 2004), this would be equivalent to the county receiving funds of $276,387 (approximately $5,264 annually) for each person in the county. Under the Proposed Action, local area government operating budgets would likely expand, increasing the level of services and infrastructure provided to community residents. These impacts would be higher under the Proposed Action than under the No Action Alternative.

The number of AJEs that would be created in the study area is estimated at 85,715.7 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would be higher than under the No Action Alternative (BLM 2005).

Under the Proposed Action, if it is assumed that all 3,396 RVDs are relocated for the LOP, reduced recreation economic activity would amount to $2.4 million present value and 92.4 AJEs. If it is assumed that all 103.7 hunter days per year are relocated for the LOP, reduction in economic activity from hunting expenditures would amount to $1.0 million present value and 49.9 AJEs. Impacts to recreation and hunting under the Proposed Action would be greater than under the No Action Alternative due to increased disturbance and longer project duration.

In summary, this alternative would have more nominal economic activity related to development and production than the No Action Alternative because of the higher level of resource recovery.

4.4.3 Alternative A

Under Alternative A, change in economic activity from current conditions would be expected from the development of up to 3,100 wells and the recovery of up to 8,191 BCF of gas and 77.81 MBO (see Table 4.21).

Over the LOP, economic activity would be $28,643.9 million present value, including $3,574.9 million present value in taxes/royalties (see Table 4.21). Nominal taxes and royalties to Sublette County would be $1,892.00 million. Based on a population of 6,654 (Year 2004), this would be equivalent to Sublette County receiving $284,340 (approximately $5,416 annually) for each person in the county. Property tax revenues would likely be higher under this alternative than under the No Action Alternative or the Proposed Action due to the greater amount of construction involved with development, which would result in an increased tax base. Because Alternative A maximizes resource recovery, at least conceptually, changes in production for this field could impact pricing of natural gas for consumers. But given the size of the market, it is not likely that a measurable change in market price would be associated with this alternative. Moreover, local area government operating budgets would likely increase more than under the No Action Alternative, but less than under the Proposed Action due to reduced development expenditures. Alternative A would generate the most overall taxes and revenues and the most funds for the school capital account over the LOP compared to all others alternatives (BLM 2005).

The number of AJEs that would be created in the study area is estimated at 85,984.2, with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would likely be similar to but increased from that described for the Proposed Action because more AJEs would be created to attract new workers (BLM 2005).

This alternative could result in a loss of present value economic activity from recreation of $2.4 million and hunting of $1.0 million. The loss of economic activity from recreation and hunting would be greater under Alternative A than under the No Action Alternative.

In summary, this alternative would have more nominal economic activity in terms of production than the Proposed Action because of the higher level of resource recovery.

4.4.4 Alternative B

Under Alternative B, change in economic activity from current conditions would be expected from the development of up to 3,100 wells and the recovery of up to 6,124 BCF of gas and 58.18 MBO (see Table 4.21). Economic activity would be $16,426.8 million present value, including $2,108.2 million present value in taxes/royalties (see Table 4.21). Nominal taxes and royalties to Sublette County would be $1,446.56 million. Based on a population of 6,654 (year 2004), this would be nominally equivalent to Sublette County receiving funds of $217,398 (approximately $2,651annually) for each person in the county (BLM 2005). Under Alternative B, property tax revenues would increase due to the increased tax base resulting from capital improvements in the JIDPA, but at a lower level than under the Proposed Action due to the decreased number of well pads. However, this alternative would result in a lower recovery of resources and a lower supply of natural gas over the long term than under the Proposed Action and may result in higher consumer prices and increased dependence on foreign supplies

While, conceptually, changes in production for this field could impact pricing of natural gas for consumers, given the size of the market it is not likely that a measurable change in market price would be associated with this alternative due to the length of the LOP. Local area government operating budgets would likely increase under this alternative when compared to the No Action Alternative, but would be less than under the Proposed Action due to reduced development expenditures and lower recovery of resources.

The number of AJEs that would be created in the study area is estimated at 86,261.9 with an average wage ranging from $31,881 to $47,173. Population changes from secondary employment would likely be similar to those of the Proposed Action.

This alternative could result in a present value loss of economic activity from recreation of $2.7 million and from hunting of $1.1 million. The loss of economic activity from recreation and hunting would be increased under Alternative B as compared to the No Action Alternative.

In summary, the least economic activity would occur under Alternative B when compared to all alternatives except for the No Action Alternative, both in nominal and real terms as well as numbers of jobs. This alternative would have less nominal economic activity in terms of production than the Proposed Action because of the lower level of resource recovery.

4.4.5 BLM Preferred Alternative

Under the Preferred Alternative, up to 3,100 new wells would be developed. Economic activity from the Preferred Alternative would be similar to that described for the Proposed Action.

4.4.6 Cumulative Impacts

The cumulative impacts assessment area for socioeconomics includes Sublette, Lincoln, and Sweetwater Counties. All of these counties depend upon the oil and gas industry for a portion of their economic activity and tax base (refer to Section 3.4.7.4). The JIDP, along with other oil and gas developments, would increase employment opportunities, expand the tax base, and improve the ability of the counties to maintain and increase services and infrastructure for residents. Increased oil and gas development results in impacts related to employment, tax base/revenues, and general economic health. Wells developed as part of this project would add proportionately to the economic benefits realized from the area. Local communities would experience economic impacts from an increase in consumption of local goods and services and increased sales tax revenues. For instance, construction of well pads and roads is usually contracted to local construction companies, and it is likely that many employees would spend some of their payroll in these communities. Actual impacts would depend on the rate of development and the number of wells authorized.

Increases in regional oil and gas development activity over a short period can cause notable changes in employment and income. These variables can also cause changes in population trends, which could have impacts on community services, social structures, and lifestyles. Under all action alternatives, increased oil and gas development is expected to cause an increase in taxes and revenues to all governments in the study area. Increases to ad valorem taxes would be expected to occur in Sublette County. Conversely, under the No Action Alternative, these increases would not be realized, which could result in negative impacts to local governments. Additional revenues would accrue to the U.S. in the form of personal and corporate income taxes. Wyoming, and especially Sublette, Sweetwater, and Lincoln Counties are highly dependent on mineral revenues, and the revenue anticipated from the proposed project would add to those revenues.

Where the surface is in private ownership and the minerals are in federal ownership, a lease holder has the right of ingress and egress on the private surface and the right to disturb whatever is reasonably necessary to recover the minerals. This does not prevent the private owner and the lease holder from entering into mutually acceptable terms regarding surface use to facilitate the process. When both the surface and minerals are in private ownership, negotiations for a lease, including financial considerations, are between the private owner and the potential lessee, and the terms of the lease, financial and otherwise, are negotiated by the two parties. It is typical for the private mineral owner to share in the profits from the recovery of the mineral resource.

A portion of the resident population, as well as many nonresidents, place great value on preserving the character of the area and are not in favor of the high level of oil and gas development proposed in JIDPA. These individuals may be affected on a personal aesthetic and moral level by the proposed project.

4.4.7 Unavoidable Adverse Impacts

There would be unavoidable short-term or long-term adverse impacts to socioeconomics as a result of the proposed project. Impacts could be reduced by implementation of suggested mitigation measures.

4.4.8 Environmental Justice

EO 12898 directs BLM to assess whether an action would have disproportionately high and adverse human health or environmental impacts on minority and/or low-income communities. The EO has three goals:

- to focus federal agency attention on the environment and human health conditions in minority communities and low-income communities;
- to promote non-discrimination in federal programs that substantially affect human health and the environment; and
- to provide minority communities and low-income communities greater access to information on, and opportunities for public participation in, matters relating to human health and the environment.

Sublette County is neither a minority community nor a low-income community (see Section 3.4.11), and no impact associated with environmental justice would occur.

4.5 LAND USE

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with land use (including status/ownership, livestock/grazing management, recreation, and transportation):

- to manage public lands to support the goals and objectives of other resource programs;
- to respond to public demand for land use authorizations;
- to acquire administrative and public access, where necessary;
- to maintain or improve the quality of land resources in the state;
- to coordinate land use decisions with economic factors and needs;
- to provide for a cooperative process of local land use planning with other governmental agencies;
- to plan for continuing use of agricultural-rural lands and for potential changes in use of these lands;
- to plan land use consistent with the orderly development, use, and conservation of renewable and nonrenewable natural resources;
- to plan for the provision of public facilities and services, including safe and efficient transportation and utility systems, in coordination with local land use policies, goals, and objectives;

- to minimize conflicts among utility corridor needs, competing land uses, and local land use plans;
- to consider the conservation and enhancement of natural resources with the economic benefit of resource development;
- to consider site-specific environmental features (e.g., soil types, wetlands, riparian areas, topography, drainage patterns) as part of land use planning decisions and in the review of development proposals;
- to plan land use in a manner that minimizes environmental pollution and disruption of natural resources;
- to establish more watering systems on all grazing lands for livestock, wildlife, and game/non-game birds;
- to support/encourage multiple-use policy implementation on federal and state lands;
- to ensure the continued availability of outdoor recreational opportunities sought by the public while protecting other resources;
- to prevent resource degradation resulting from recreation and other uses and to provide for the anticipated increase in recreational uses on BLM-administered lands;
- to conserve and develop scenic resources for the benefit of present and future generation; and
- to encourage recreational enterprise while preserving natural values.

Impacts to land use would be significant if project activities precluded other current uses of the JIDPA for the long term, if there would be a reduction in AUMs of a magnitude that would require modification in grazing allotments or other actions that would prevent the realization of grazing management goals, or if project activities resulted in a violation of BLM RMP or other land use plan goals/objectives. Impacts to land use are assumed to be proportional to the amount of short-term and/or LOP disturbance for all alternatives. Impacts would primarily result from surface-disturbing activities and/or the presence of oil and gas developments. Impacts to land use, specifically grazing and recreation, would be significant in the short term under all project alternatives (see Sections 4.5.2 and 4.5.3, respectively).

4.5.1 Status/Ownership

The current JIDPA land uses of livestock grazing (see Section 4.5.2), natural gas production (see Section 4.1.4), wildlife habitat (see Section 4.2.2), and recreation—primarily hunting (see Section 4.5.3)—are anticipated to continue for the LOP under all alternatives. Further development of the JIDPA primarily for natural gas extraction would alter the historic land use pattern for the LOP. There is the potential for some impacts to existing roads on the area if these roads are not adequately upgraded prior to their use for the project. Natural gas recovery would continue to be the dominant use of the JIDPA and would maintain the changed character of the landscape from a relatively undisturbed area (prior to about 1996) to one with industrial development; however, other existing uses are not anticipated to be excluded as defined in

Section 103(1) of FLPMA. After the LOP, land use likely would revert back to primarily livestock grazing, wildlife habitat, and recreation under all alternatives.

Ownership of surface and mineral estates in the JIDPA are anticipated to be unchanged under all alternatives; therefore, no significant impacts to land status/ownership are anticipated from the project.

4.5.1.1 No Action Alternative

Under the No Action Alternative, there would be no additional activities that would potentially affect land status or ownership, as previously identified for the area and including oil and gas development on 2,811 acres in the short term and 1,409 acres over the LOP (BLM 1998b, 2000b). Natural gas production is currently the dominant use of the JIDPA and would continue to be the dominant use for approximately 63 years.

4.5.1.2 The Proposed Action

Under the Proposed Action, the ownership of surface and mineral estates in the JIDPA are anticipated to be unchanged, but natural gas development and production operations would increase compared to the No Action Alternative, resulting in approximately 16,200 acres of new surface disturbance. Short-term (14,388 acres) and LOP (6,043 acres) disturbance would total 20,409 acres. The duration of impact under the Proposed Action would be approximately 76 years.

4.5.1.3 Alternative A

Implementation of Alternative A would result in the same types of impacts and surface disturbance as the Proposed Action (see Section 4.5.1.2). However, natural gas development would occur in areas that would have been avoided under other action alternatives. Duration of impact would be approximately 76 years.

4.5.1.4 Alternative B

Implementation of Alternative B would result in the same types of impacts as the No Action Alternative but would result in an increase of 3,222 acres of new surface disturbance from that of the No Action Alternative. Short-term (4,848 acres) and LOP 2,602 acres) disturbance would total 7,431 acres. Impact duration would be approximately 105 years.

4.5.1.5 BLM Preferred Alternative

Implementation of the Preferred Alternative would result in the same types of impacts as the No Action Alternative but would result in an increase of an estimated 9,821–16,125 acres of new surface disturbance from that of the No Action Alternative. Short-term (9,782–14,388 acres) and LOP (4,267–6,020 acres) disturbance would total 14,030–20,334 acres. Project duration is anticipated to be approximately 76 years.

If the Operators maximize ongoing reclamation as described in Section 2.4.5, total acres affected would be comparable to that of the Proposed Action (20,334 acres vs. 20,409 acres). However, under the Preferred Alternative, additional mitigation and monitoring measures would be implemented to ensure achievement of specific management objectives and to minimize project-related impacts (see Section 2.4.5). No specific measures are identified for land status/ownership.

However, many of the measures identified for other resources (e.g., vegetation, wildlife, livestock, recreation) would mitigate, to some extent, impacts to land status.

4.5.1.6 Cumulative Impacts

The CIAA for land status/ownership is the JIDPA and the leases that extend beyond the project area; therefore, cumulative impacts would be the same as the impacts described for each of the alternatives above. Landownership would not change, and natural gas recovery would continue to be a dominant use but not to the exclusion of other existing uses. After the LOP, land use would revert back to livestock grazing, wildlife habitat, and recreation.

4.5.1.7 Unavoidable Adverse Impacts

There would be no unavoidable adverse impacts to land status/ownership.

4.5.2 Livestock/Grazing Management

The major premise in analyzing each alternative's impacts to the livestock forage resource is the linear rationale that for every 10 acres of vegetation removed in construction of the Jonah gas field there will be approximately one AUM of livestock forage lost. This would indeed be true, and impacts would be significant, if the selected alternative resulted in an unvegetated landscape that failed to meet the forage demands of the permitted livestock.

Section 3.5.2 describes how livestock forage demands are currently being met in the wake of several years of natural gas drilling in the area of analysis. Consequently, it is unrealistic to assume that forage (AUMs) will be lost proportionately to the degree of development in any particular alternative. Therefore, it is premature to assume that grazing permits will be reduced as a result of alternative implementation. This could occur if reclamation were unsuccessful, but any reduction in grazing permits can only be determined after an interpretation of rangeland monitoring data indicate a need to do so.

If and when results of monitoring indicate that forage to satisfy permitted use is lacking, or that livestock use is preventing the accomplishment of other resource objectives, then the process outlined in 43 CFR 4110.3 will be used to make necessary adjustments in grazing management.

Other potential impacts that may occur relative to the industrial development include loss of livestock to hazards such as increased traffic. The construction of additional roads and associated reclamation efforts could affect the pattern of livestock forage utilization on the JIDPA and could concentrate animals along roads and on reclaimed areas, thus increasing the chances of vehicle/livestock collisions. Construction activities could result in shifts in livestock distribution patterns, causing them to concentrate on and around reclamation areas. Open pits and trenches, if not properly fenced, can result in death or injury to livestock. Also, increased road/well densities would cause an increase in the amount of fugitive dust and its accumulation on forage and in the air, thereby increasing the potential for "dust pneumonia" in cattle, as well as decreasing forage palatability. These development associated impacts may occur regardless of the alternative selected, and would be proportionate to the amount of allowable activity.

4.5.2.1 No Action Alternative

Under the No Action Alternative, there would be no additional impacts to livestock/grazing management other than those already approved for the area, which include 4,001 acres of disturbance in the JIDPA, including 1,348 acres of disturbance over the LOP (BLM 1998b, 2000b).

Blue Rim Desert Common Allotment

Because the Burma Road would not be upgraded under the No Action Alternative, no impacts would occur to the Blue Rim Desert Common Allotment.

Stud Horse Common Allotment

Livestock grazing would continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Sand Draw Common Allotment

Livestock grazing would continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Boundary Allotment

Livestock grazing would continue at the permitted levels in conjunction with adaptive management strategies, including rangeland and reclamation monitoring. Watershed condition and forage availability could be reevaluated in the future based upon monitoring data and reclamation success. The allotment would be expected to, at a minimum, meet the Wyoming Standards for Healthy Rangelands.

4.5.2.2 The Proposed Action

The Proposed Action assumes 20,126 acres of disturbance in the JIDPA, including 5,962 acres of disturbance over the LOP.

Blue Rim Desert Common Allotment

The Burma Road upgrade will require reclamation along the roadsides and will attract cattle to the planted areas. Increased traffic and increased speed will increase the potential for vehicular collisions with cattle.

Stud Horse Common Allotment

There would be significant potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Sand Draw Common Allotment

There would be significant potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Boundary Allotment

There would be significant potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies, including rangeland and reclamation monitoring. Watershed condition and forage availability could be reevaluated in the future based upon monitoring data and reclamation success. The allotment would be expected to, at a minimum, meet the Wyoming Standards for Healthy Rangelands.

4.5.2.3 Alternative A

As with the Proposed Action, this alternative assumes 20,126 acres of total disturbance in the JIDPA, including 5,962 acres of disturbance over the LOP.

Blue Rim Desert Common Allotment

The Burma Road upgrade will require reclamation along the roadsides and will attract cattle to the planted areas. Increased traffic and increased speed will increase the potential for vehicular collisions with cattle.

Stud Horse Common Allotment

There would be significant potential for a decrease in livestock forage under this alternative as in the Proposed Action for a decrease in livestock forage, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Sand Draw Common Allotment

There would be significant potential for a decrease in livestock forage under this alternative as in the Proposed Action, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Boundary Allotment

As in the Proposed Action, there would be significant potential for a decrease in livestock forage under this alternative depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies, including rangeland and reclamation monitoring. Watershed condition and forage availability could be reevaluated in the future based upon monitoring data and reclamation success. The allotment would be expected to, at a minimum, meet the Wyoming Standards for Healthy Rangelands.

4.5.2.4 Alternative B

This alternative assumes 7,223 acres of total disturbance in the JIDPA, including 2,541 acres of disturbance over the LOP.

Blue Rim Desert Common Allotment

Because the Burma Road would not be upgraded under Alternative B, no impacts would occur to the Blue Rim Desert Common Allotment.

Stud Horse Common Allotment

There would be considerable potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Sand Draw Common Allotment

There would be considerable potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Boundary Allotment

There would be considerable potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies, including rangeland and reclamation monitoring. Watershed condition and forage availability could be reevaluated in the future based upon monitoring data and reclamation success. The allotment would be expected to, at a minimum, meet the Wyoming Standards for Healthy Rangelands.

4.5.2.5 BLM Preferred Alternative

This alternative assumes 13,822–20,126 acres of total disturbance in the JIDPA, including 4,090–5,962 acres of disturbance over the LOP.

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives (i.e., maintain permitted livestock AUMs) and to minimize impacts to resources (see Section 2.4.5).

Blue Rim Desert Common Allotment

Because the Burma Road would not be upgraded under the Preferred Alternative, no impacts would occur to the Blue Rim Desert Common Allotment.

Stud Horse Common Allotment

There would be considerable potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Sand Draw Common Allotment

There would be considerable potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies including rangeland and reclamation monitoring.

Boundary Allotment

There would be considerable potential for a decrease in livestock forage under this alternative, depending on the results of reclamation efforts. Livestock grazing will continue at the permitted levels in conjunction with adaptive management strategies, including rangeland and reclamation monitoring. Watershed condition and forage availability could be reevaluated in the future based upon monitoring data and reclamation success. The allotment would be expected to, at a minimum, meet the Wyoming Standards for Healthy Rangelands.

4.5.2.6 Cumulative Impacts

The CIAA for livestock/grazing includes all of the four grazing allotments (Blue Rim Desert Common, Stud Horse Common, Sand Draw Common, and Boundary) that may be affected by the proposed project. These four allotments cover 120,597 acres and contain a total of 9,876 AUMs. RFD surface disturbance in these allotments is estimated to be approximately 396 acres in the long term and would be associated with development for the Pinedale Anticline Project. Therefore, maximum cumulative short-term impact (i.e., the combined existing, proposed, and RFD disturbance) could potentially result in significant forage loss if reclamation strategies were not applied on a timely schedule and/or were unsuccessful. Maximum long-term cumulative AUM loss within all allotments is estimated to be insignificant, as current observation of reclamation results appears to be keeping up with AUM demand by livestock. Cumulative impacts to livestock/grazing across alternatives would be proportional to the extent of surface disturbance and development features/human activity. There is also a potential for well-field facilities to reach a density such that it is impractical to move cattle into the area.

4.5.2.7 Unavoidable Adverse Impacts

The project would result in the temporary and potentially long-term loss of available livestock forage, depending on reclamation results. Decreases in livestock forage would be determined through rangeland monitoring.

4.5.3 Recreation

Impacts to recreation would be considered significant if project development changes the recreational use of the JIDPA or would result in a violation of BLM RMP or other land use plan recreation objectives. Impacts to recreation are assumed to be proportional to the amount of development for all alternatives. Dispersed recreation opportunities would be lost from the JIDPA for the LOP under all project alternatives including the No Action Alternative, resulting in significant impacts for the LOP under all alternatives.

No developed recreation sites or facilities are present in or immediately adjacent to the JIDPA; therefore, no significant impacts to sites or facilities are anticipated. Project-improved roads may promote some increased recreational use (e.g., driving for pleasure, sightseeing, desire to view a natural gas field). However, long-term displacement or elimination of existing dispersed recreation due to increased levels of gas field development activity is anticipated. In addition, some potential recreational visitors would likely avoid the JIDPA because of a reduction in the quality of the recreational experience, especially for hunting, camping, wildlife watching, and OHV activities.

Outdoor recreation is important both in terms of the satisfaction it provides residents of the region and for the activity it generates in the region's economy as a result of expenditures by nonresident visitors; the economic impacts associated with project-affected recreation are described in Section 4.4. Hunting pressure for any species on the JIDPA is likely to be directly related to wildlife population size, structure, and availability. Under all alternatives, populations of pronghorn and greater sage-grouse, which are the two primary hunted species on the JIDPA, would likely be displaced to such an extent that recreational hunting on the JIDPA may no longer occur (see also Section 4.2.2). However, lands adjacent to the JIDPA could, and likely would, absorb displaced hunting pressure because displaced wildlife would in part also likely move to adjacent lands. It is anticipated that not all wildlife would move to alternate locations, and that their breeding, nesting, brood-rearing, and foraging opportunities would in part be jeopardized; therefore, the wildlife populations currently found on the JIDPA are anticipated to decline. This would result in the loss of potential recreational opportunities associated with wildlife (e.g., hunting, wildlife viewing, photography), and associated recreational opportunities and revenues from these activities would also be lost.

4.5.3.1 No Action Alternative

Under the No Action Alternative, there would be no additional impacts to recreation other than those that have occurred as a result of approved development in the Jonah Field (i.e., loss of dispersed recreation and hunting for the 63-year LOP and until areas are adequately reclaimed) as detailed in past NEPA documents (BLM 1998b, 2000b). Under all alternatives, including the No Action Alternative, the Recreation Opportunity Spectrum (ROS) classification for the JIDPA is expected to change from semi-primitive motorized to rural or urban as a result of approved and existing development. Impacts on dispersed recreation opportunities may be significant; however, no additional significant impacts beyond those of previously authorized actions are anticipated.

4.5.3.2 The Proposed Action

Under the Proposed Action, impacts to recreational opportunities are anticipated to increase from levels under the No Action Alternative as 3,100 new well pads and associated roads would be constructed. Duration of impacts would be for the 76-year LOP and until areas are adequately reclaimed. ROS classification changes would be as noted in the No Action Alternative. Impacts on dispersed recreation opportunities under the Proposed Action may be significant.

Upgraded conditions on the Luman and Burma Roads would likely be retained after project completion, allowing for increased recreational use of the area. This improvement of non-paved road for oil and gas projects opens new areas for recreational use outside of the project area. New access and increased awareness of opportunities could encourage existing and new recreational use of previously primitive or semi-primitive areas. This could displace traditional recreational users with more new users and different uses (e.g., OHV).

4.5.3.3 Alternative A

Impacts to recreation under Alternative A would be the same as those of the Proposed Action. However, under this alternative, selected Operator-committed and BLM-required area-avoidance practices would not be implemented; therefore, increased impacts to pronghorn antelope, greater sage-grouse, raptors, and other wildlife are anticipated due to disturbance in habitat buffers. This would likely result in decreased wildlife populations and subsequent reductions in hunting and wildlife viewing opportunities. Duration of impacts would be for the LOP and until areas are adequately reclaimed (approximately 76 years). ROS classification changes would be as noted in the No Action Alternative. Impacts on dispersed recreation opportunities under Alternative A may be significant. Impacts resulting from upgraded road conditions would be the same as those of the Proposed Action.

4.5.3.4 Alternative B

Implementation of Alternative B would result in the same types of impacts to recreation as No Action but would likely occur at increased levels due to expanded development period (approximately 42 years). Impacts would likely be reduced from those of the Proposed Action due to the absence of disturbance in portions of the JIDPA. Duration of impacts would be for the LOP and until areas are adequately reclaimed (approximately 105 years). ROS classification changes would be as noted in the No Action Alternative. Impacts on dispersed recreation opportunities under Alternative B may be significant. Impacts resulting from upgraded road conditions would be similar to those of the Proposed Action except that the Burma Road would not be upgraded.

4.5.3.5 BLM Preferred Alternative

Under the Preferred Alternative, impacts to recreational opportunities are anticipated to be of the same type as all other alternatives and would be comparable, if all acres potentially available for development credit following successful interim reclamation are utilized, to impacts under the Proposed Action. Duration of impacts would be for the LOP and until areas are adequately reclaimed (approximately 76 years). ROS classification changes would be as noted in the No Action Alternative. Impacts on dispersed recreation opportunities under the Preferred Alternative may be significant. Impacts resulting from upgraded road conditions would be similar to those of the Proposed Action except that the Burma Road would not be upgraded.

While no recreation-specific mitigations for reducing impacts to recreation are proposed under the Preferred Alternative, any measure that reduces the volume of surface disturbance and human presence as well as those measures that minimize adverse effects to wildlife has the potential to reduce impacts to recreation (see Sections 2.3 and 2.4.5).

4.5.3.6 Cumulative Impacts

The CIAA for recreation, totaling 1,557,558 acres, is shown on Map 3.23. Existing surface disturbance impacting recreation opportunities throughout the CIAA is 138,740 acres (216 square miles) or 6.6% of the CIAA, which is primarily a result of agriculture (83%), road and pipeline ROWs (12%), and existing natural gas development in the Jonah, Pinedale Anticline, Fontenelle, Moxa, Stagecoach Draw, LaBarge Platform, Riley Ridge, and Mesa Verde project areas (5%) as well as the Tip-Top and Hogsback Units. The extent of development throughout the CIAA has and will continue to result in displaced recreational use from these areas and added pressure on existing recreational opportunities and facilities elsewhere within the CIAA.

Maximum cumulative disturbance (i.e., the combined alternative-specific and RFD disturbance) in the recreation CIAA for all alternatives is presented in Table 4.22. Cumulative impacts to recreation are anticipated to be similar under all development alternatives. ROS classifications may be altered as human activities increase in areas adjacent to the JIDPA.

Table 4.22. Cumulative Acreage of Disturbance in the Recreation CIAA, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Cumulative Impact Analysis Area (CIAA)	Total Acreage of CIAA	Existing Disturbance in CIAA, outside JIDPA	RFD	Disturbance					
				No Action			**Proposed Action and Alternative A**		
				JIDP Total	LOP	Cumulative[1]	JIDP Total	LOP	Cumulative[1]
Recreation	1,557,558	84,352	7,014	4,209	1,409	95,575	20,409	6,043	111,775
Percent of Entire CIAA		5.4				6.1			7.2
				Alternative B			**Preferred Alternative**		
				JIDP Total	LOP	Cumulative[1]	JIDP Total	LOP	Cumulative[1]
Recreation				7,431	2,602	98,797	14,030–20,334	4,267–6,020	105,396–111,700
Percent of Entire CIAA						6.3			6.7–7.2

[1] Cumulative disturbance = outside JIDPA + RFD + JIDPA total.

A large proportion of workers employed for this project would likely be hired from the local workforce. However, regional and local populations are increasing, in part from natural gas development projects, and this increase is creating an additional demand for recreation facilities and public access areas. Within the CIAA, traditional dispersed recreation has been and will continue to be directed away from areas with increased road and well development for the long term due to a reduction in the quality of the recreational experience on the part of most traditional users. Some individuals may no longer recreate in the area at all. Current users of recipient areas may be adversely affected by increased use, overcrowding, and a feeling that the quality of the recreation experience of solitude has diminished.

4.5.3.7 Unavoidable Adverse Impacts

Some level of unavoidable adverse impact to recreation is anticipated under all alternatives due to the likely avoidance of the JIDPA by recreational visitors.

4.5.4 Transportation

Impacts due to traffic volume would be considered significant if the proposed project resulted in the inability of the BLM, the State of Wyoming, and/or Sublette County to achieve land use planning objectives for transportation. Because the design of new and upgraded roads in the JIDPA would be in compliance with the BLM road standard guidelines (BLM 1985, 1991a), the Transportation Plan for this project (Appendix B, subappendix DP-A), individually approved APD and ROW road specifications, and continued Sublette County and WDOT consultation would occur, no significant transportation impacts are anticipated under any alternative. Furthermore, the project would be implemented with mitigation as identified in Appendices A and C. Further detail on transportation planning and effects is provided in the project Transportation Plan (Appendix B, subappendix DP-A).

Up to 465 miles of new resource roads and 8 miles of new collector roads would be required for this project (Table 4.23). Impacts to existing, upgraded, and newly constructed roads could result from inadequate road maintenance resulting in road failure. While maintenance agreements would be established by Operators, adverse weather conditions coupled with increased traffic may result in roads being temporally impassable (i.e., stuck vehicles, vehicles driving off roads). Increased traffic volumes are anticipated under all alternatives except the No Action Alternative. For the LOP and especially during development, traffic increases may cause congestion and road damage and an increased potential for vehicle collisions.

Table 4.23. Miles of New Roads, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Alternative	Miles of New Resource Roads[1]	Miles of New In-Field Collector Roads	Miles of Burma Road Upgrade
No Action Alternative	0	0	0
Proposed Action	465	8	12
Alternative A	465	8	12
Alternative B	0	0	0
Preferred Alternative	465	8	0

[1] Based on 0.4 mile per well pad.

For impact analysis, it is assumed that transportation impacts would be greatest during development and would be proportional to the rate of development (i.e., the faster the development pace, the greater the impact to transportation).

4.5.4.1 No Action Alternative

The current estimate of existing and/or approved roads in the JIDPA is approximately 199 miles (see Table 4.23). Under the No Action Alternative, transportation impacts would continue at existing approved levels (no new roads), the Burma Road would not be upgraded, and the duration of impacts would be approximately 63 years. A total of approximately 1,063,900 round trips, which could occur to and from any location in the JIDPA, or approximately 73 round trips per day is anticipated under the No Action Alternative for the LOP (Appendix B). Prior decisions found that the existing approved Jonah Field developments would be unlikely to have significant transportation impacts (BLM 1998b, 2000b).

4.5.4.2 The Proposed Action

Under the Proposed Action, approximately 465 miles of resource roads, 8 miles of new collector/local roads, and 12 miles of Burma Road improvement would be required for field development (see Table 4.23). A total of approximately 8,698,600 round trips or approximately 496 round trips per day is anticipated under the Proposed Action for the LOP (Appendix B). This is an increase of 7,634,700 round trips when compared to the No Action Alternative. The length of the Proposed Action and therefore increased traffic volumes is estimated to be 76 years.

4.5.4.3 Alternative A

Under Alternative A, impacts would be the same as for the Proposed Action; however, some of the new roads would be built in areas that would be avoided under other project alternatives.

4.5.4.4 Alternative B

Under Alternative B, impacts would be similar to those of the No Action Alternative in that no new well pads or roads would be built (see Table 4.21). Impacts would increase from the No Action Alternative due to new development and would increase from the Proposed Action during development due to the increased time necessary to drill the additional directional wells; however, during production, impacts would be decreased from the Proposed Action and all other development alternatives because traffic would occur only to the existing pads. The Burma Road would not be upgraded. A total of approximately 8,202,300 round trips or approximately 468 round trips per day is anticipated under Alternative B for the LOP (Appendix B). This is an increase of 7,138,400 round trips when compared to the No Action Alternative. Duration of impacts would be an estimated 105 years.

4.5.4.5 BLM Preferred Alternative

Under the Preferred Alternative, impacts would be similar to those for the Proposed Action, except the Burma Road would not be upgraded and additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5). Any measure that reduces the volume of human presence or centralizes development actions has the potential to reduce impacts to transportation. Furthermore, those measures associated with the Jonah Interagency Office (JIO) also could reduce impacts to transportation through appropriate planning.

4.5.4.6 Cumulative Impacts

Cumulative impacts from traffic resulting from the project in combination with other regional projects and overall regional growth could be significant. The project would be the major contributor to increased traffic on secondary roads within the JIDPA. Field development would result in increased traffic volumes on major highways (especially on U.S. Highway 191, a major tourist corridor) and on county and local roads. Increased traffic would result in an increased potential for public traffic hazards and other safety and road maintenance concerns. However, the magnitude of the increase would depend on alternative-specific development levels and development rates (i.e., 75 or 250 new wells developed per year). Existing major highways and county roads are adequate to handle anticipated increased traffic (Appendix B). The costs of maintaining county and local roads would be borne, to some extent, by Operators primarily through tax payments. Cumulative impacts on transportation are anticipated to be slightly beneficial for the long term as an increase in available roads, improved road conditions, and increased revenues for state-sponsored road improvements occur. It is anticipated that the upgraded conditions on the Burma and Luman Roads would be retained after project completion allowing for increased recreational use of the area under all alternatives, although to different degrees depending on whether the Burma Road is upgraded.

4.5.4.7 Unavoidable Adverse Impacts

Unavoidable adverse impacts to transportation would occur for the LOP primarily as a result of increased traffic and the expanded road network.

4.6 VISUAL RESOURCES

The BLM PFO and RSFO RMP RODs (BLM 1988b,1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with visual resources:

- to maintain or improve scenic values and visual quality and to establish priorities for managing the visual resources in conjunction with other resource values; and

- to conserve and develop scenic resources for the benefit of present and future generations.

The BLM defines a significant impact to visual resources, on federal lands and minerals, as project-related development that would not meet VRM class objectives for an area. A significant impact would occur if oil and gas development becomes the dominant feature in the landscape where the objectives for that land are to maintain the existing character of the landscape. Impacts to visual resources on federal lands and minerals are also defined as an apparent visual change, to the casual observer, from a natural landscape to an "industrialized appearing" landscape. Due to the presence of natural gas development as a dominant visual feature throughout the JIDPA, as well as project effects such as haze, nighttime lighting, increased traffic, and short-term visible smoke plume events, visual resource impacts are anticipated under all alternatives for the LOP and until areas are adequately reclaimed. Significant visual resource impacts would not occur within the JIDPA specifically because the entire JIDPA is considered a Class IV VRM area. The project under all alternatives is generally consistent with Class IV objectives, but impacts may be significant when viewed from locations where the JIDPA and/or project effects (e.g., light sources, haze, smoke plumes) are visible. Non-JIDPA areas where project effects may be visible include VRM Class I and II areas, including wilderness and wilderness study areas. Project-related effects and features visible from U.S. Highway 191 would be consistent with VRM Class III objectives.

4.6.1 No Action Alternative

Under the No Action Alternative, there would be no new impacts to visual resources beyond those already approved for Jonah Field developments. The duration of impacts would be approximately 63 years and until areas are adequately reclaimed. While past NEPA decisions for the project identified no significant impacts to visual resources (BLM 1998b, 2000b), significant visual resource impacts from the existing developments have since been identified as described above. No additional significant impacts beyond those of previously authorized actions are anticipated under the No Action Alternative.

4.6.2 The Proposed Action

Implementation of the Proposed Action would result in a continuation of the existing long-term visual characteristics of the JIDPA as a developed natural gas field with increased impacts to visual resources from that of the No Action Alternative due to increased development and prolonged LOP. Increased natural gas field developments would include greater well pad densities, more miles of roads and associated traffic, and more ancillary facilities. Impact duration is anticipated to be approximately 76 years and until areas are adequately reclaimed. Impacts may be significant in some non-JIDPA areas, including VRM Class I and II areas.

4.6.3 Alternative A

Implementation of Alternative A would result in the same types and volumes of visual resource impacts as the Proposed Action; however, there would be increased visual resource impacts in the resource buffer areas that would have otherwise been avoided under the other project alternatives. Duration of impacts would be approximately 76 years). Impacts may be significant in some non-JIDPA areas, including VRM Class I and II areas.

4.6.4 Alternative B

Implementation of Alternative B would result in the same types of impacts as the No Action Alternative but would be increased due to expanded development. Impacts would be reduced from the other project alternatives because no new well pads or roads would be built. Duration of impacts would be approximately 105 years. Impacts may be significant in some non-JIDPA areas, including VRM Class I and II areas.

4.6.5 BLM Preferred Alternative

Under this alternative, visual resource impacts are anticipated to be similar to those of the Proposed Action, but slightly less as the Operators would implement unique development procedures (see Section 2.4.5). Because the BLM Preferred Alternative would limit total surface disturbance at any given time to a maximum of 14,030 acres and the Proposed Action has no such limits, it is possible that at any given time visual impacts from surface disturbance may be less under this alternative. Duration of impacts would be approximately 76 years. Impacts may be significant in some non-JIDPA areas, including VRM Class I and II areas.

Under the Preferred Alternative, additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5). Any measure that reduces regional haze or smoke plumes, the volume of surface disturbance, human presence, and/or traffic, as well as those measures that minimize adverse effects on vegetation or facilitate enhanced reclamation have the potential to reduce impacts to visual resources.

4.6.6 Cumulative Impacts

The CIAA for visual resources, totaling 2,089,363 acres, is shown on Map 3.24. The surface disturbance resulting from each of three of the alternatives (the Proposed Action, Alternative A, and the BLM Preferred Alternative) would likely exceed 20,000 acres. All of this disturbance would occur on areas designated as VRM Class IV. Maximum cumulative disturbance for the visual resources CIAA (i.e., the combined existing, proposed, and RFD disturbance) for each of these alternatives is 8.0% of the CIAA (Table 4.24). The RFD includes 7,302 acres of new disturbance primarily from natural gas developments in other project areas in the CIAA.

Class IV areas allow for management activities that require major modifications to the existing character of the landscape. Although the activities may dominate the view of the casual observer and the relative change to the landscape may be high, all management activities must be conducted to minimize the impact to the visual quality of the area. Under all project alternatives, the JIDPA and its contributing developments and visual attributes (including haze, smoke plumes

Table 4.24. Cumulative Acreage of Disturbance in the Visual Resources CIAA, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Cumulative Impact Analysis Area (CIAA)	Total Acreage of CIAA	Existing Disturbance In CIAA, Outside JIDPA	RFD	Disturbance					
				No Action			**Proposed Action and Alternative A**		
				JIDP Total	LOP	Cumulative[1]	JIDP Total	LOP	Cumulative[1]
Visual Resources	2,089,363	138,740	7,302	4,209	1,409	150,252	20,409	6,043	166,452
Percent of Entire CIAA		6.6				7.2			8.0
				Alternative B			**Preferred Alternative**		
				JIDP Total	LOP	Cumulative[1]	JIDP Total	LOP	Cumulative[1]
Visual Resources				7,431	2,602	153,474	14,030–20,334	4,267–6,020	160,072–166,376
Percent of Entire CIAA						7.3			7.7–8.0

[1] Cumulative disturbance = outside JIDPA + RFD + JIDPA total.

and night lighting), along with other regional developments, are visible and may be noticeable to the casual observer from areas outside the project area, including VRM Class II and I areas within the CIAA such as a BLM wilderness study area and the Bridger Wilderness. Therefore, significant cumulative impacts to regional visual resources may occur at these sites.

4.6.7 Unavoidable Adverse Impacts

The expansion of gas development facilities, and various development effects (e.g., haze, smoke plumes, nighttime lighting effects on regional star-gazing) and associated roads would be an unavoidable adverse impact to visual resources on the JIDPA and at locations where it is visible outside the JIDPA.

4.7 HAZARDOUS MATERIALS

The PFO and RSFO RMP RODs (BLM 1988b, 1997b) and land use plans for the State of Wyoming (WSLUC 1979) and Sublette County (SCBC and SCPC 2003) identify the following management goals/objectives associated with hazardous materials:

- to protect public and environmental health and safety on BLM-administered public lands;
- to comply with applicable federal and state laws;
- to prevent waste contamination due to any BLM-authorized action;
- to minimize federal exposure to the liabilities associated with waste management on public lands; and
- to integrate hazardous materials and waste management policies and controls into all BLM programs.

Impacts associated with hazardous materials would be considered significant if project activities resulted in violations of the aforementioned goals/objectives and/or local, state, and federal laws. Impacts to soils, surface water and groundwater resources, and wildlife could result from accidental hazardous materials spills, pipeline ruptures, and/or exposure to hazardous materials. It is likely that only small amounts of soil potentially would be contaminated and, should this occur, the affected area would be cleaned up in an appropriate and timely manner (Appendix B). Proper containment of oil and fuel in storage areas, containment of fluids in reserve pits, appropriate pipeline design and construction, proper well casing and cementing, and location of wells away from drainages (all but Alternative A) would prevent potential surface water and groundwater contamination. Project operations would comply with all relevant federal and state laws regarding hazardous materials and with directives identified in the Hazardous Materials Summary for this project (Appendix B) and existing SPCCPs.

With the implementation of the aforementioned procedures plus the additional mitigations and practices identified in Appendices A, B, and C, no significant impacts are anticipated under any project alternative.

4.7.1 No Action Alternative

Under the No Action Alternative, there would be no new developments and associated opportunities for material spills, pipeline ruptures, and/or exposure to hazardous materials above present levels and as previously approved for the JIDPA. Prior NEPA documents concluded that there would be no significant adverse impacts involving hazardous materials (BLM 1998b, 2000b). The duration for potential impacts would be for the LOP, which is anticipated to be approximately 63 years and until all potentially contaminated sites are remediated.

4.7.2 The Proposed Action

Under the Proposed Action Alternative there would be an approximate six-fold increase (from 533 approved wells to 3,100 new wells) in the potential for material spills, pipeline ruptures, and/or exposure to hazardous materials above current approved levels. The duration for potential impacts would be for the LOP, which is anticipated to be approximately 76 years and until all potentially contaminated sites are remediated.

4.7.3 Alternative A

Implementation of Alternative A would have the same potential for hazardous material impacts as the Proposed Action. However, potential impacts to wildlife and surface waters would be increased in some areas because selected wildlife and drainage buffers would not be avoided. The duration for potential impacts would be for the LOP, which would be approximately 76 and until all potentially contaminated sites are remediated.

4.7.4 Alternative B

Implementation of Alternative B would have the same potential types of hazardous material impacts as the No Action Alternative; however, impacts would be increased due to the addition of new wells, pipelines, and produced materials. Compared to the Proposed Action, however, the potential for accidental hazardous materials spills, pipeline ruptures, and/or exposure to hazardous materials would be reduced because development and production activities would be limited to the existing well pads and roads because no new pads or roads would be constructed.

The duration for potential impacts would be approximately 105 years and until all potentially contaminated sites are remediated.

4.7.5 BLM Preferred Alternative

Under the Preferred Alternative, the types of potential impacts would be the same as under the No Action Alternative, but there would be an approximate six-fold increase in the potential for material spills, pipeline ruptures, and/or exposure to hazardous materials above current approved levels (from 533 wells [No Action] to 3,100 new wells). The duration of the impacts would be approximately 76 years and until all potentially contaminated sites are remediated.

Impacts under the Preferred Alternative would be similar to those of the Proposed Action, except additional mitigation and monitoring measures would be applied to facilitate achievement of specific management objectives and to minimize impacts to resources (see Section 2.4.5). Any measure that reduces the overall level of development, the number of proposed facilities or facility locations, and/or traffic, as well as any actions that facilitate enhanced reclamation have the potential to reduce potential hazardous material impacts.

4.7.6 Cumulative Impacts

All existing, proposed, and future development projects would use mitigation measures similar to those described for this project (Appendix B) to prevent soil contamination, surface water and groundwater pollution, and wildlife exposure; therefore, cumulative impacts from hazardous materials are expected to be as described above for the various project alternatives and are not anticipated to be significant. There would, however, be some increased potential for hazardous material impacts associated with expanded regional developments associated with other oil and gas projects.

4.7.7 Unavoidable Adverse Impacts

With strict adherence to identified hazardous material management requirements (Appendix B), no unavoidable adverse impacts are anticipated.

4.8 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible and irretrievable commitment of resources is defined as a permanent reduction of resources that, once lost, cannot be regained. The degree of loss would be dependent upon the alternative implemented. The primary irreversible and irretrievable commitment of resources for this project would result from the recovery of the natural gas and condensate reserves from the Lance Pool (see Section 4.1.4). These recovered reserves would no longer be available; however, some reserves would remain and could be recovered in the future with improved technology. Other permanent irreversible and irretrievable commitments of resources would include soils lost through water or wind erosion (see Section 4.1.7); accidental or inadvertent destruction and/or vandalism of cultural (see Section 4.3) or paleontological (see Section 4.1.6) resources; loss of wildlife due to direct mortality (see Section 4.2.2); and the labor, materials, and energy expended during project-related activities (see Appendix B).

4.9 SHORT-TERM USE OF THE ENVIRONMENT VS. LONG-TERM PRODUCTIVITY

For the purposes of this discussion, short-term use of the environment is that use during the LOP, whereas long-term productivity refers to the period after the project is completed and the area is adequately reclaimed. Short-term use of the JIDPA for natural gas recovery for the LOP would not affect the long-term productivity of the area. LOP commitments of resources would include loss of vegetation productivity (see Section 4.2.1), wildlife habitat/habitat function (see Section 4.2.2), and livestock forage (see Section 4.5.2) on lands devoted to project activities (e.g., well pads, roads) until these areas are adequately reclaimed. After the project is completed and disturbed areas are reclaimed, the same resources that were present prior to project activities would be available, except for the natural gas and oil resources (see Section 4.1.4). It may take 20 years or more after the LOP for some of the reclaimed areas to revegetate to predisturbance levels; however, reclamation would eventually provide conditions to support wildlife, livestock, and recreation. Use of the JIDPA during the LOP would not preclude the subsequent long-term use of the area for any purpose for which it was suited prior to the project.

CHAPTER 5 — ADDITIONAL POTENTIAL MITIGATION, MONITORING MEASURES, AND COMPENSATORY MITIGATION MEASURES

This chapter provides a summary of mitigation and monitoring actions that could be applied to the project to further minimize adverse impacts or verify the presence, extent, or absence of anticipated impacts. This list itemizes mitigation, monitoring, and compensatory mitigation (CM) that have been identified by the public and/or Interdisciplinary Team (IDT) members and that are not already specifically included as measures applicable to all or to several alternatives (see Section 2.3), as measures specific to the BLM Preferred Alternative (see Section 2.4.5), or included in the Operator-committed practices detailed in Appendix C.

Each measure listed in this chapter is briefly summarized and includes an identification of how application of the measure may influence project effects. A summary of CM as currently proposed by EnCana is also provided, as are some possible CM ideas, including estimated costs where available and identification of which resource(s) might benefit from each type of CM project.

Mitigation measures fall within the actions the Secretary of the Interior can direct to prevent unnecessary or undue degradation of the public lands and protect surface resources in the approval of surface use plans. Mitigation, as defined by the CEQ in 40 CFR 1608.20, may include one or more of the following:

(1) Avoiding the impact altogether by not taking a certain action or parts of an action;

(2) Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

(3) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

(4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

(5) Compensating for the impact by replacing, or providing substitute resources or environments.

Any of the actions listed below may be required or recommended under any alternative if this project is approved. Decisions regarding the inclusion or exclusion of these actions will be made in the ROD for this project.

5.1 ADDITIONAL MITIGATION/MONITORING OPPORTUNITIES

The JIO could be established under any ROD-approved alternative except the No Action Alternative, and the JIO could consider any of the following measures for application to the project as part of its annual recommendations to the BLM. Following JIO recommendation, BLM could require certain actions, or make appropriate recommendations to affected governments, agencies, and/or applicable Operators. Operators could voluntarily apply these measures with or without JIO recommendation.

5.1.1 Air Quality

The following actions could further identify, quantify, and reduce overall project emissions, which in turn could reduce impacts to visibility, atmospheric deposition, vegetation, wildlife, and other resources potentially affected by fugitive dust and emissions.

5.1.1.1 BLM Goals and Performance Objectives

BLM has established goals and objectives to measure its performance in meeting air quality requirements. The goals are qualitative descriptions of BLM's desired condition of air quality, and the objectives are measurable benchmarks of BLM's attainment of the goals. The reader should note that attainment of these performance objectives requires actions by many agencies, as well as BLM. The intent of the air quality goals and performance objectives is that BLM would:

- Air Quality Goal 1a: Minimize the impact of management actions in the planning area on air quality by complying with all applicable air quality laws, rules, and regulations.
    - Air Quality Objective 1a.1: Maintain concentrations of criteria pollutants associated with management actions in compliance with applicable Wyoming and National Ambient Air Quality Standards (WAAQS, NAAQS).
    - Air Quality Objective 1a.2: Maintain concentrations of Prevention of Significant Deterioration (PSD) pollutants associated with management actions in compliance with the applicable increment.
- Air Quality Goal 1b: Implement management actions in the planning area to improve air quality as practicable.
    - Air Quality Objective 1b.1: Reduce visibility-impairing pollutants, in accordance with the reasonable progress goals and time-frames established within the State of Wyoming's Regional Haze State Implementation Plan (SIP).
    - Air Quality Objective 1b.2: Reduce atmospheric deposition pollutants to levels below federally established levels of concern (LOC) and levels of acceptable change (LAC).

5.1.1.2 Mitigation and Monitoring

BLM would apply AQ Goal 1a to concentrations of criteria and PSD pollutants, and AQ Goal 1b to atmospheric deposition and visibility. Existing air quality monitoring sites are shown in Table 5.1.

Table 5.1. Existing Air Quality Monitoring

	Location	Current Funding	Air Quality Components
SLAMS State & Local Air Monitoring Stations	Pinedale	WDEQ	Particulate matter ($PM_{2.5}$)
SPM Special Purpose Monitors	Jonah Boulder Daniel	EnCana Shell/WDEQ WDEQ	Nitrogen dioxide Ozone Particulate matter (PM_{10}), Visibility
CASTNet Clean Air Status & Trends Network	Pinedale	EPA and others	Nitrogen compounds Ozone Sulfur compounds, Dry deposition
WARMS Wyoming Air Resources Monitoring System	Pinedale	BLM Wyoming	Nitrogen compounds Particulate matter ($PM_{2.5}$) Sulfur compounds
NADP	Bridger Wilderness	BLM Wyoming	Wet deposition
Lakes	Bridger, Fitzpatrick, and Popo Agie	USFS	Lake chemistry

Emissions Tracking

The BLM would work cooperatively with state and other federal agencies, and with industry, to track emissions in the Pinedale Field Office area.

- BLM would track numbers of wells, numbers of drill rigs, drilling emissions, and compressor stations
- The Wyoming Department of Environmental Quality, Air Quality Division (WDEQ-AQD) would continue to track permitted emissions
- Operators would provide BLM with information on their drill rigs, including drilling days, horsepower, load factors, and emission factors.

Concentrations

Potential concentrations were all below applicable WAAQS and NAAQS (see TRC EC 2006:Tables G-ES-1 and G-ES-4). BLM plans no additional mitigation focused on potential concentrations. In the case of ozone, however, it may become necessary for BLM to develop a strategy to mitigate impacts in the future. While developing the current EIS, BLM learned of exceedances of the levels of the ozone NAAQS that occurred in the Jonah field in February 2005; however, the factors contributing to these levels were unclear. In cooperation with the JIO established under the ROD, BLM would review ozone data collected in the area. If in the future air monitoring were to show ozone exceedances that were attributable at least in part to sources in the Jonah field, BLM would consult with WDEQ-AQD, EPA, USFS, and NPS to determine whether adaptive management would be needed to mitigate impacts. WDEQ has the regulatory authority to determine a NAAQS violation. To date, there is no finding of a NAAQS violation.

BLM would continue to work cooperatively with WDEQ, EPA, USFS, and NPS to maintain concentration monitoring in the Pinedale Field Office (PFO) area. Existing concentration monitoring includes regulatory (SPM and SLAMS) and non-regulatory (CASTNet and WARMS) networks (Table 5.1).

BLM would also work cooperatively with other federal and state agencies and industry to enhance concentration monitoring in the PFO area. BLM and the cooperating agencies would contribute technical expertise to maintaining and enhancing air quality monitoring. The Operators would bear the financial costs of maintaining and enhancing air quality monitoring.

WDEQ is developing a joint funding agreement with federal agencies and industry to finance and operate air quality monitoring in southwest Wyoming. Operators would be required to participate in any joint industry/state/federal monitoring agreement.

Ozone monitoring would continue at existing air monitoring stations in the region under the regulatory authority of WDEQ-AQD or the non-regulatory review of CASTNet. These authorities would periodically assess the networks and may add, move, or terminate ozone monitoring.

WDEQ is currently performing a regulatory PSD Increment Consumption Analysis for southwest Wyoming, and preliminary results are available at http://deq.state.wy.us/aqd. That analysis will be available in early 2006, and will present the status of the NO_2 increment consumption in Bridger and Fitzpatrick Wilderness Areas. BLM may provide a more informative PSD comparison in the State of the Atmosphere annual reports. This comparison, similar to the current comparison, will not constitute a regulatory PSD Increment Consumption Analysis.

Atmospheric Deposition

Potential atmospheric deposition values were all below applicable LOC and LAC (see TRC EC 2006:Tables G-ES-1 and G-ES-4). BLM plans no additional mitigation focused on atmospheric deposition.

BLM would continue to work cooperatively with WDEQ, EPA, USFS, and NPS to maintain atmospheric deposition monitoring in the PFO area. Existing atmospheric deposition monitoring includes: NADP wet deposition monitors (Pinedale, South Pass, Gypsum Creek), CASTNet dry deposition monitor (Pinedale), bulk deposition sites (Black Joe Lake, Hobbs Lake) and long-term lake sites (Black Joe, Hobbs, Deep, Upper Frozen, Ross, Saddlebag).

BLM would also work cooperatively to enhance atmospheric deposition monitoring in the PFO area. BLM and the cooperating agencies would contribute technical expertise to maintaining and enhancing air quality monitoring. The Operators would bear the financial costs of maintaining and enhancing air quality monitoring.

WDEQ is developing a joint funding agreement with federal agencies and industry to finance and operate air quality monitoring in southwest Wyoming. Operators would be required to participate in any joint industry/state/federal monitoring agreement.

Visibility

Potential visibility values were above applicable significance criteria for both project and cumulative impacts in Bridger Wilderness and other Class I areas (see TRC EC 2006: Tables G-ES-1 and G-ES-4). BLM would require the Operators to demonstrate annually that emission reductions from the Jonah Infill Project will reduce the potential impact to visibility as follows:

Demonstration Period: Operators in the JIDPA would begin a 12-month demonstration period beginning with the signing of the ROD. In correspondence with BLM, WDEQ affirmed the State's position that BLM "require the use of Tier II diesel technology on drill rigs used in the Jonah area at the earliest possible date" (WDEQ 2005). Because preliminary modeling conducted for the DEIS indicated that emissions from engines for drilling rigs would have to be further reduced to attain the air quality goals stated above, BLM treats emission factors for Tier 2 engines (EPA 1998) as a reference point for the minimum control of emissions during the demonstration period. Operators in the Jonah and Pinedale fields have suggested several technologies that could achieve emissions lower than Tier 2. As part of this demonstration period, the Operators in the Jonah field would conduct emission tests on various drilling engine technologies as defined in a plan to be developed by the Operator(s) and approved by WDEQ-AQD. The results from this demonstration period would be provided to WDEQ as soon as possible, but no later than 1 year after the ROD is signed. WDEQ would then consider the emissions testing data in the determination of the appropriate Best Available Technology (BAT) for the engines associated with all drilling operations. Until such time as the WDEQ-AQD establishes appropriate BAT standards, Operators would be required to demonstrate that the impact levels from the proposed project will be less than the impact levels of the 80% emission reduction scenario as described in FEIS Section 4.1.2.5 and AQTSD Appendix G, Section G-2. Within 90 days of the ROD, the Operators would submit a plan to BLM that describes in detail how the potential impacts will be minimized.

Implementation Period: All Operators would comply with WDEQ-established BAT standards. In the absence of WDEQ-established BAT standards, the Operators would submit annual operating plans that report the emissions from all emitting units in order to demonstrate that the potential visibility impact from the proposed project will be less than the potential visibility impact levels of the 80% emission reduction scenario described in FEIS Section 4.1.2.5 and AQTSD Appendix G, Section G-2, at a minimum, and to demonstrate that any potential visibility impact decreases as soon as possible to no days with an impact greater than 1 deciview (dv).

Based upon emissions data collected during the demonstration period, BLM would run an air dispersion model, comparable to the model run for the AQIAS, to reassess air quality impacts. BLM, in conjunction with the JIO, would use the results of the model to assess whether emission controls in the JIDPA adequately control emissions to achieve the air quality goals. Annually thereafter, BLM would determine whether an additional model run is necessary based upon field-wide emissions or a comparable indicator selected by BLM (in cooperation with the JIO). Operators should continue to innovate by demonstrating and using new techniques for controlling emissions after the demonstration period.

The method by which the Operators would demonstrate potential project visibility impact would be determined by BLM in consultation with WDEQ, EPA, USFS, and NPS. BLM would rely on the Operators to determine how they would attain the reduction in potential visibility impacts from the Jonah Infill project.

Technological advances in drill rig engines as well as aftermarket engine control represent great potential to reduce emissions from project development. In general, the more advanced the emission-reduction technology of drill rigs, the more wells per year could be drilled to net the same impact.

BLM's performance objective for visibility would be attained if actual visibility monitored by the Bridger Wilderness IMPROVE aerosol sampler complies with the reasonable progress goal of the Wyoming Regional Haze State Implementation Plan. Also, BLM would report the occurrence of layered hazes as measured by the visibility cameras operated by WDEQ-AQD. It is BLM's goal that the occurrences of layered hazes decrease over the life of the Jonah Infill project.

BLM would continue to work cooperatively with WDEQ, EPA, USFS, and NPS to maintain visibility monitoring in the PFO area. Existing visibility monitoring includes camera sites (Boulder, Daniel, Jonah), and IMPROVE aerosol and transmissometer sites (Bridger Wilderness).

BLM would also work cooperatively to enhance visibility monitoring in the Pinedale Field Office area. The BLM and the cooperating agencies will contribute technical expertise and financial resources to maintaining and enhancing air quality monitoring. The Operators would bear the financial costs of maintaining and enhancing air quality monitoring.

WDEQ is working on developing a joint funding agreement with federal agencies and industry to finance and operate air quality monitoring in southwest Wyoming. Operators would be required to participate in any joint industry/state/federal monitoring agreement.

5.1.2 Topography

The following action could protect important or unique topographic features in the JIDPA, which in turn could reduce soil erosion and protect the wildlife habitats provided by these features:

- no disturbance at rock outcrops in the JIDPA.

5.1.3 Paleontology

The following action could protect important or unique paleontological features in the JIDPA by identifying their location and subsequently restricting project activities that could disturb them:

- an active program of inventory and evaluation of sediments known or suspected to contain paleontological materials and an assessment of cumulative impacts.

5.1.4 Soil Resources

The following actions could protect soils by reducing erosion, compaction, loss through mixing with unsuitable plant growth material, and the time necessary for disturbance to be reclaimed. By reducing soil erosion, these actions could also protect surface water quality and promote revegetation, which in turn could promote the provision of forage for livestock and wildlife. These actions include:

- site-specific predisturbance landscape descriptions, including soils data, plant species composition and cover data, and proposed reclamation seed mixes with application rates;

- analyze soils prior to disturbance to determine appropriate reclamation seed mixtures and potential soil amendment needs; and

- utilization of fertilizers or other soil amendments at reclamation sites to facilitate site re-vegetation.

5.1.5 Surface Water Resources

The following actions could protect surface water resources and could protect groundwater quality in areas where surface water percolates below the ground surface. There is to be no surface discharge of wastewater from facilities in the JIDPA. Additional potential measures to protect water resources include:

- utilize catchment basins, sediment retention ponds, and/or spreader dikes within or external to the JIDPA to capture potentially increased flows due to runoff from disturbed areas to prevent channel morphology damage;
- monitor channel condition in the JIDPA with photopoints and/or other appropriate methods in coordination with BLM;
- no additional linear crossings (road and/or pipeline crossings/crossing corridors) of Sand Draw and/or other ephemeral drainages, unless it can be proven that such activity would reduce the erosive potential of the JIDPA and could be accomplished with no disturbance to the drainages;
- develop and implement an adaptive surface water management plan for the entire JIDPA which could include the NPDES process and consider runoff on a cumulative watershed basis;
- pipeline crossings of all drainage channels could be fitted with shutoff valves or other systems to minimize accidental discharge and facilitate channel protection from contamination in the event of a pipeline break;
- maximize recycling of waters utilized and produced for this project and increase capacities to both treat and re-use clean produced water within the field;
- consider all practical methods and technological improvements that would increase the use of recycled water, and decrease fresh water withdrawals, erosion, and salt loading of surface soils and water bodies; and
- file all NPDES permits and associated water quality data with the BLM and consult with WDEQ, WGFD, BLM, and livestock permittees before any water release.

5.1.6 Vegetation, Including TEP&C and BWS Plant Species

The following actions could protect vegetation, including TEP&C and BWS plant species and protect soils, water quality, and wildlife habitat and livestock forage:

- scalping and post-construction ripping rather than removal and re-spreading of topsoil for all new pipelines;
- establish vegetative plots to scientifically evaluate reclamation success, to develop appropriate procedures for timely sagebrush reestablishment, and/or to further identify the most desirable reclamation species; and

- in coordination with the BLM, Natural Resources Conservation Service, and Sublette County Conservation District, Operators could utilize irrigation at reclamation sites to improve germination and vegetation establishment.

5.1.7 Wildlife, Including TEP&C and BWS Animal Species

The following actions could protect wildlife, including TEP&C and BWS animal species and soils, vegetation, and water quality resources:

- utilization of low-profile tanks within line-of-sight, up to a maximum of 0.5 mile, of greater sage-grouse leks;
- develop water sources within the JIDPA that are outside of areas with a high level of development for area wildlife and/or convert existing project-developed water wells for wildlife use when they are no longer required;
- avoid all raptor nest territories (rather than just active nests) during the nesting season;
- expand annual wildlife monitoring in the JIDPA and Wildlife Study Area to include new wildlife/habitat study opportunities identified in consultation with the BLM, WGFD, and/or USFWS;
- modify wildlife protection measures (e.g., altered buffer area sizes, seasonal restriction dates) based on the results of annual monitoring and/or other regional wildlife studies;
- develop habitat enhancement projects on the JIDPA to accommodate displaced wildlife or altered migration routes; and
- inventory the Big Piney white-tailed prairie dog complex for black-footed ferrets and pursue a block clearance of the complex.

5.1.8 Cultural Resources

The following actions could protect cultural resources:

- Initiation of a Programmatic Agreement/Cultural Resources Management Plan (PA/CRMP) with SHPO;
- develop and implement a research design, discovery plan, and/or cultural resource management plan for the combined areas of the Pinedale Anticline Project Area and JIDPA, and consult with SHPO pursuant to the effect of these plans on affected cultural resources;
- implement larger cultural resource survey areas for site-specific development actions (areas of potential effect); and
- intensify data collection efforts at affected high-value archaeological sites in exchange for disturbance of sites with less unique values.

5.1.9 Land Use/Livestock Grazing

The following actions could protect livestock from hazards associated with development:

- Operators could commit to work with BLM and affected livestock permittees to mitigate the loss of AUMs in the JIDPA through provision of range improvement projects to modify grazing distribution patterns (e.g., water developments, vegetation treatments, irrigation, fencing, use of herders, actions that improve carrying capacity) within the project-affected allotments;

- Operators could commit to reduce fugitive dust on all proposed roads to decrease the potential for dust pneumonia in cattle; and

- Operators could commit to converting project-developed water wells for livestock use when they are no longer required for the project.

5.1.10 Land Use/Recreation

The following actions could minimize adverse project effects to JIDPA recreation by providing a new tourism opportunity:

- provide one or more quality interpretive sites with public access and/or publications with public distributions to provide the general public and interested parties educational information regarding JIDPA developments and management actions for other area-specific natural resource values.

5.1.11 Land Use/Transportation

The following actions could reduce impacts to roads, the transportation network, the traveling public, air quality, soils, vegetation, wildlife, livestock grazing, and recreation:

- prepare road development and transportation management plans;

- utilize car pools and/or bus crews from communities of origin to the field to minimize commuting traffic;

- utilize existing roads in the JIDPA as collector and/or resource roads to the maximum extent possible to avoid new surface disturbance; and

- Operators could jointly develop and submit for BLM approval road maintenance and use agreements designating road development, maintenance, and use requirements by each Operator. These agreements could identify responsibilities for necessary preventative and corrective road maintenance throughout the LOP. Maintenance responsibilities could include, but not be limited to, blading, gravelling or aggregate-surfacing, cleaning ditches and drainage facilities, dust abatement, noxious weed control, culvert maintenance and repair, or other requirements.

5.1.12 Visual Resource

Additional measures identified for vegetation and wildlife habitat (reclamation actions) and transportation (reduced traffic volumes) could also benefit visual resources. The following measure could also reduce project impacts to the visual resource:

- Funding a hosted worker (visual resource management specialist) or other such qualified consultant to work with the BLM and Operators to monitor and minimize visual effects. This position could be required until such time it is determined that both short- and long-term VRM objectives would be accomplished.

5.1.13 Health and Safety/Hazardous Materials

The following measures could protect public and worker health and safety and improve BLM's inspection and enforcement capability:

- provide the BLM copies of field- or lease-specific SWPPPs, SPCCPs, Spill Response Plans, and Emergency Response Plans; and

- thoroughly purge pipelines prior to abandonment.

5.1.14 Other Actions

The following actions or recommendations could enhance various resource protections, facilitate field management, or assist other entities with management decisions. These actions include:

- implement Operator-committed practices under any approved alternative when not already committed to (see Appendix B, Exhibit B-1) or required by BLM;

- establish the JIO under any approved alternative;

- utilize new drilling and development technologies (e.g., laser drilling, natural gas powered drill rig engines, micro-hole drilling, mat drilling) as they become available and feasible, and develop research or pilot projects to test new development technologies;

- utilize new technologies or technological innovations as they become available and feasible to minimize pad/road/pipeline/ancillary facility footprints and/or other adverse impacts;

- as a method of obtaining defensible data over the LOP to prove the success of reclamation efforts on a landscape scale, monitor both background and JIDPA-boundary "first flush" total suspended solids (TSS) using low-cost collection vessels placed at key locations (culverts), and monitor over the LOP in coordination with the JIO;

- increase bond amounts for JIDPA developments. Such action could ensure that sufficient funds are available to reclaim disturbed areas in the event Operators inadequately implement reclamation;

- Operator surveyors could submit electronic data for wells, roads, pipelines, and other project infrastructures in a format suitable to the BLM. Provision of electronic data would allow for consistency among project data across Operators and would facilitate BLM database management. This action could benefit all area resources potentially affected by specific project development features (e.g., wildlife, habitats);

- Operators could provide hosted workers to the BLM as needed throughout the project development phase or LOP. If applied, this measure could facilitate efficient and timely BLM permitting; and

- utilize smaller ROWs to disturb less surface area during pipeline construction and initially install larger diameter pipelines to minimize pipeline disturbance corridor widths. If applied, this measure could reduce all impacts associated with linear surface disturbances.

5.2 COMPENSATORY (OFF-SITE) MITIGATION

Preliminary research and monitoring results, as well as the project impacts reported herein, indicate that existing surface disturbance especially in combination with certain project alternatives may be appropriate for CM. Some Operators have also acknowledged that the level of development that would occur under the Proposed Action and other alternatives presented in the EIS would result in impacts that cannot be sufficiently mitigated within the JIDPA.

As a general guideline, CM may be considered after other forms of on-site mitigation, including BMPs, have been analyzed. In other words, while on-site mitigation is the first priority when mitigating significant impacts, CM is an available tool for enhancing mitigation when impacts to BLM resources cannot be adequately mitigated on the site where the impacts are occurring.

To comply with BLM Instruction Memorandum (IM) 2005-069, a signed cooperative agreement between all affected parties, including BLM, the Operators, and applicable state resource management agencies, would be required before any funds can be transferred or received. Additionally, BLM would retain final approval authority for all proposed mitigation projects.

Considering projected impacts under each of the alternatives in the FEIS, BLM Wyoming identified CM as necessary to adequately offset or mitigate adverse on-site impacts. Though CM must be volunteered by the Operators prior to being included in a ROD, it is the BLM's opinion, in consultation with the WGFD, that CM should be applied.

In general, off-site mitigation or CM for direct surface disturbance impacts to wildlife would be necessary at a minimum rate of 3:1 (off-site treatments to on-site disturbance), with the goal of off-site treatments being to provide improvements and/or protection to other comparable habitat areas within relatively close proximity to the JIDPA. As an example, if the development approved 10,000 acres of direct surface disturbance, a minimum of 30,000 acres of off-site habitat treatment would be required. For other impacted resources that could not be adequately mitigated on-site, CM would be considered acceptable on a 1:1 basis. Under no circumstances would implementation of CM measures obviate the Operator's requirement to comply with all on-site mitigation and monitoring, outcome-based performance objectives, COAs, BMPs, and/or Operator-committed practices.

5.2.1 Operator-proposed CM

EnCana (Personal Communication, November 11, 2005, Letter from John Schopp, EnCana Vice President, Northern Rockies Business Unit, to Robert Bennett, BLM Wyoming State Director) is committed to funding certain levels of offsite mitigation or CM depending on the level of future surface disturbance authorized, through subsequent applications of APD and ROW approvals by the BLM in the ROD for the Jonah Infill Drilling Project (Table 5.2). Funding levels are as indicated below for the following five developments scenarios:

1. In the event the BLM selects an alternative in the ROD which authorizes between 8,300 and 9,999 acres of new surface disturbance, EnCana would contribute 5.5 million dollars to fund offsite mitigation projects and monitoring in and around the JIDPA. At least $1.5 million of the total $5.5 million would be deposited with the State of Wyoming Wildlife and National Resources Trust Account Board and would be dedicated to funding habitat improvement projects on lands around the JIDPA. As directed by the BLM, a portion of the remaining balance of the CM funds may be used to fund other positive environmental impacts including monitoring, inspection, and enforcement activities in and around the JIDPA.

2. In the event the BLM selects an alternative in the ROD which authorizes between 10,000 and 10,999 acres of new surface disturbance, EnCana would contribute 12.1 million dollars to fund offsite mitigation projects and monitoring in and around the JIDPA. At least 7.5 million dollars of the total 12.1 million dollars would be deposited with the State of Wyoming Wildlife and National Resources Trust Account Board and would be dedicated to funding habitat improvement projects on lands around the JIDPA. As directed by the BLM, a portion of the remaining balance of the CM funds may be used to fund other positive environmental impacts including monitoring, inspection, and enforcement activities in and around the JIDPA.

3. In the event the BLM selects an alternative in the ROD which authorizes between 11,000 and 11,999 acres of new surface disturbance, EnCana would contribute 19.7 million dollars to fund offsite mitigation projects and monitoring in and around the JIDPA. At least 13.5 million dollars of the total 19.7 million dollars would be deposited with the State of Wyoming Wildlife and National Resources Trust Account Board and would be dedicated to funding habitat improvement projects on lands around the JIDPA. As directed by the BLM, a portion of the remaining balance of the CM funds may be used to fund other positive environmental impacts including monitoring, inspection, and enforcement activities in and around the JIDPA.

4. In the event the BLM selects an alternative in the ROD which authorizes between 12,000 and 16,999 acres of new surface disturbance, EnCana would contribute 24.5 million dollars to fund offsite mitigation projects and monitoring in and around the JIDPA. At least 16.5 million dollars of the total 24.5 million dollars would be deposited with the State of Wyoming Wildlife and National Resources Trust Account Board and would be dedicated to funding habitat improvement projects on lands around the JIDPA. As directed by the BLM, a portion of the remaining balance of the CM funds may be used to fund other positive environmental impacts including monitoring, inspection, and enforcement activities in and around the JIDPA.

5. In the event the BLM selects an alternative in the ROD which authorizes at least 16,200 acres of new surface disturbance, EnCana would contribute 28.5 million dollars to fund offsite mitigation projects and monitoring in and around the JIDPA. At least 20.5 million dollars of the total 28.5 million dollars would be deposited with the State of Wyoming Wildlife and National Resources Trust Account Board and

would be dedicated to funding habitat improvement projects on lands around the JIDPA. As directed by the BLM, a portion of the remaining balance of the compensatory mitigation funds may be used to fund other positive environmental impacts including monitoring, inspection, and enforcement activities in and around the JIDPA.

Table 5.2. EnCana Proposed CM Funding, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

Amount of Additional Surface Disturbance Authorized in the Jonah Drilling Project ROD	Funding Distribution		Total
	State of Wyoming Wildlife and Natural Resources Trust Account Board for Offsite Wildlife Habitat Improvement Projects	Other Positive Environmental Projects Including Monitoring, Inspection, and Enforcement Activities	
16,200 or Greater Acres New Initial Surface Disturbance	$20.5 million	$8 million	$28.5 million
Between 12,000 and 16,199 Acres New Initial Surface Disturbance	$16.5 million	$8 million	$24.5 million
Between 11,000 and 11,999 Acres New Initial Surface Disturbance	$13.5 million	$6.2 million	$19.7 million
Between 10,000 and 10,999 Acres New Initial Surface Disturbance	$7.5 million	$4.6 million	$12.1 million
Between 8,300 and 9,999 Acres New Initial Surface Disturbance	$1.5 million	$4 million	$5.5 million

EnCana's contribution to CM would be distributed as requested by the BLM so long as no more than 20% of the total commitment is paid out in any one year. Although EnCana is committed to funding CM as described above, EnCana hopes that other Operators in the JIDPA would agree to voluntarily contribute to CM funding in which case EnCana's contribution would be proportionately reduced.

EnCana understands that the CM funds would be distributed in accordance with an appropriate document such as a memorandum of understanding, agreement, or cooperative agreement between the BLM, the State of Wyoming Wildlife and Natural Resources Trust Account Board, and any potentially impacted State of Wyoming divisions, agencies, or boards (see Appendix F). EnCana further understands that the funds designated for onsite and offsite monitoring, studies, and enforcement activities would be administered by the BLM or some other entity selected by the BLM and designated in the ROD for the Jonah Infill Drilling Project.

5.2.2 Other Compensatory Mitigation Ideas

It is assumed that any BLM-approved CM project would reduce impacts to the same or similar resources impacted by project activities, or would substitute resources for those impacted by the project. However, any quantitative analysis of beneficial effects of CM cannot be identified until specific projects are proposed and it is known what specific impacts a project is intended to mitigate. The BLM may include other affected federal agencies and the State of Wyoming in discussions regarding selection of specific CM projects, and may provide opportunity for public input.

In lieu of EnCana proposed CM, the Operators could voluntarily develop proposals, submit those proposals to BLM for approval, and fund and implement the BLM-approved CM projects.

The following list provides some of the types of CM activities that could be undertaken to mitigate for impacts within the JIDPA that cannot be fully mitigated on-site, to substitute similar resources for those not able to be mitigated on-site in the JIDPA, or to provide tangible benefits similar to those that would have been provided with successful on-site mitigation in the JIDPA. Included with each CM idea an estimated cost, where available, and the resources whose impacts might be mitigated by that type of project. There is no implied prioritization to the list, nor is the list intended to be exhaustive.

Assist with funding for a WDEQ emissions inspector for the JIDPA for 5 years, or financially assist WDEQ and USFS with ongoing air quality monitoring in the Upper Green River area; consultation with the USFS and WDEQ/AQD to develop and implement a consistent funding mechanism to continue existing on- and off-site air quality monitoring actions at Class I airsheds and sensitive lakes. Monitoring at local communities and/or at other potentially affected sites could also be implemented.

- Impacted resource potentially benefited: Air quality
- Cost estimate: $15,000 to $100,000 per year

Install an engineered headcut stabilization structure in the Alkali Creek drainage outside the JIDPA

- Impacted resources potentially benefited: Soils, topography, surface water, stream channel morphology and stability
- Cost estimate: $10,000 to $15,000

Purchase a conservation easement on an irrigated hay meadow adjacent to existing greater sage-grouse habitat that is as close to the JIDPA as possible, that is not encumbered by fluid mineral leases, and restore that meadow to sagebrush vegetation similar to the adjacent sagebrush community

- Impacted resources potentially benefited: Soils, vegetation, greater sage-grouse and other sagebrush-obligate species
- Cost estimate: Conservation easements could vary from a few thousand to several million dollars, depending on size and location; restoration costs, likely less than $500,000

Purchase ROW(s) and install water improvement on an area near the JIDPA where forage is underutilized for lack of water

- Impacted resources potentially benefited: Wildlife including TEP&C and BWS, soils, surface water, vegetation, livestock grazing
- Cost estimate: ROWs could vary from several hundred to several thousand dollars, depending on size and location; water improvement costs, likely less than $100,000

Purchase a large block of sagebrush ecosystem land as close as possible to the JIDPA, that is unencumbered by fluid mineral leases and is adjacent to existing greater sage-grouse habitat, and enhance sagebrush habitat function on that land for the LOP at a ratio of 3:1, or three acres enhanced for every acre impacted in the JIDPA

- Impacted resources potentially benefited: Wildlife including TEP&C and BWS, vegetation, soils
- Cost estimate: Land prices vary from several thousand to tens of millions of dollars, depending on existing use, location, and parcel size; enhancement activity costs, likely less than $500,000

Purchase development rights on grasslands in the area that are unencumbered by fluid mineral leases, and enhance forage production

- Impacted resources potentially benefited: Wildlife including TEP&C and BWS, vegetation, soils, visual, recreation, livestock grazing
- Cost estimate: Development rights costs vary considerably with location and parcel size, and could vary from several thousand to several million dollars; forage enhancement costs, likely less than $500,000

Assist local government with funding of public service projects such as city sewage treatment facility upgrade, mosquito abatement, or West Nile virus inoculation programs

- Impacted resource potentially benefited: Socioeconomic
- Cost estimate: Several thousand to several million dollars

Purchase conservation easements and establish and maintain 3 ferruginous hawk or bald eagle or burrowing owl nesting sites as close as possible to the JIDPA, and facilitate continued occupation of those nests for LOP

- Impacted resource potentially benefited: Wildlife
- Cost estimate: Cost of conservation easement + up to $10,000

Work with impacted communities to develop and fund "portable" infrastructure enhancements (infrastructure provided by Operators during "boom" peaks, removed by Operators during "bust" times)

- Impacted resource potentially benefited: Socioeconomic
- Cost estimate: Several thousand to several million dollars

Work with WyDOT and/or Sublette County Road and Bridge to install appropriate road-side signs outside the JIDPA that indicate potential hazards (e.g., school bus stops, high-traffic volume turnouts, trucks entering roadway)

- Impacted resource potentially benefited: Socioeconomic
- Cost estimate: Likely less than $10,000

Develop wildlife habitat improvements designed to increase huntable/viewable species populations

- Impacted resource potentially benefited: Socioeconomic, recreation, wildlife
- Cost estimate: Several thousand to several million dollars

Develop rangeland improvement projects designed to increase the stability of ranching operations that depend on the use of federal forage, and intermingled private and state-owned forage, in the JIDPA.

- Impacted resource potentially benefited: rangelands
- Cost estimate: $10 to $20 per acre for improvements.

Develop partnerships between industry, private recreation providers, non-governmental organizations, county governments, State of Wyoming, and BLM that improve recreation opportunities, benefit public health, and enhance regional tourism opportunities.

- Impacted resource potentially benefited: recreation
- Cost estimate: several thousand to perhaps $500,000

Secure public access to recreational or visual opportunities where existing access across private, state or county lands is at risk or does not currently exist. This includes acquisition and/or negotiation of ROWs, easements, agreements, etc., for public access.

- Impacted resource potentially benefited: recreation and visual resources
- Cost estimate: several thousand to several million dollars

CHAPTER 6 — CONSULTATION AND PREPARERS

The list of preparers and participants, including BLM IDT members and cooperating State of Wyoming personnel and offices, is presented in Table 6.1. Personnel contacted or consulted during preparation of this EIS and scoping respondents are listed in Table 6.2.

Table 6.3 lists the names and affiliations (if known) of those who submitted written comments during the DEIS comment period from February 11, 2005, through April 12, 2005. Persons who submitted air quality-related comments on the DEIS or comments on the August 2005 *Draft Air Quality Technical Support Document Supplement* and/or the August 2005 *Air Quality Impact Analysis Supplement* through October 7, 2005, are shown in Table 6.4.

Table 6.1. List of Preparers and Participants, Jonah Infill, Drilling Project, 2006

Name	EIS Responsibility
BLM Interdisciplinary Team	
Denver Regional Office	
Craig Nicholls	Air Quality/Climate
Paul Sommers	Water Resources
State Office	
Roy Allen	Socioeconomics
Susan Caplan	Air Quality/Climate
Mark Gorges	Compliance Review
Dale Hanson	Paleontology
Ken Henke	Hazardous Materials
Janet Kurman	Compliance Review
Vickie Mistarka	Compliance Review
Brenda Vosika Neuman	Compliance Review
Ken Peacock	Water Resources
Tom Rinkes	Wildlife
Dave Roberts	Threatened, Endangered, Proposed, Candidate, and BLM Sensitive Species
Rick Schuler	Water Resources, Soils
Pinedale Field Office	
Keith Andrews	Wildlife; Threatened, Endangered, Proposed, Candidate, and BLM Sensitive Species
Frank Bain	Topography/Physiography, Geology, Paleontology
Steve Belinda	Threatened and Endangered Wildlife
Martin Hudson	Recreation, Visual Resources
Carol Kruse	Project Management
Bill Lanning	Assistant Project Management/Team Lead, Entire Document

Table 6.1. (Continued)

Name	EIS Responsibility
Steve Laster	Vegetation/T&E Vegetation, Land Use/Agriculture/Grazing/Recreation
Richard Rieman	Mineral Resources
Karen Rogers	GIS Coordinator
Pauline Schuette	Wildlife/Threatened and Endangered Wildlife
Mike Stiewig	Project Management
David Vlcek	Cultural Resources/Historic Resources
Bill Wadsworth	Land Use, Transportation
Rock Springs Field Office	
Rick Canterbury	Soils, Reclamation, Topography/Physiography
Dennis Doncaster	Water Resources, Soils
Jay D'Ewart	Land Use/Grazing
Jim Glennon	Vegetation/T&E Vegetation
John Henderson	Fisheries Resources
State of Wyoming Team	
Cara Casten	Air Quality/Climate
Susan Child	Project Management/Team Lead, Proposed Action and Alternatives
Matt Hoobler	Vegetation/T&E Vegetation, Land Use/Agriculture/Grazing/Recreation
Tom Collins	Wildlife Resources/T&E Wildlife/Wild Horses, Fisheries
Richard Currit	Cultural Resources/Historic Resources
Rod DeBruin	Geology/Geologic Hazards/Paleontology
Chris Fallbeck	Land Use/Agriculture/Grazing/Recreation
Kim Floyd	Cultural Resources/Historic Resources
Don Likwartz	Mineral Resources
Lisa Lindeman	Socioeconomics
Jeremy Lyon	Water Resources
Todd Parfitt	Noise/Odor
Darla Potter	Air Quality/Climate
Jodee Pring	Water Resources, Hazardous Materials
Scott Smith	Wildlife Resources/T&E Wildlife/Wild Horses, Fisheries
David Spencer	Socioeconomics
Timothy L. Stark	Transportation
Maxim Technologies	
Pete Guernsey	Quality Assurance
SWCA Environmental Consultants	
Jeff Connell, AICP	Socioeconomic Analysis
Charles Coyle	Project Manager
Lisa Dickerson	Project Administration; Public Comment Analysis
Camille Ensle	Public Comment Analysis
Chris Garrett, P.HGW	Water Resources, Soils
Al Herson, JD, FAICP	NEPA Compliance

Table 6.1. (Continued)

Name	EIS Responsibility
Dorothy House	Task Leader, Public Comment Analysis, Technical Editor
Ken Houser	Project Director
Ken Kertell	Biological Resources
Cynthia Manseau	Technical Editor
Peter Masson	Project Coordinator
Kathryn Mays	Socioeconomic Analysis
Elizabeth Moser	Public Comment Analysis
Michael O'Hara	Public Comment Analysis
Scott Phillips	Cultural Resources
Chris Query	GIS/CADD
Sarah Springer	Publications Specialist
TRC Environmental Corporation	
Susan Connell	Air Quality/Climate
Cassady Marshall	Air Quality/Climate
Brian Mitchell	Air Quality
Jim Zapert	Air Quality/Climate
TRC Mariah Associates Inc.	
S.L. Tiger Adolf	Socioeconomics, Environmental Justice
Bill Batterman	Cultural Resources/Historic Resources
Randall Blake	Wildlife and Fisheries Resources, GIS
Karyn Coppinger	Geology/Minerals, Paleontology, Soils, Topography/Physiography, Groundwater
Larry DeBrey	Transportation, Hazardous Materials
Genial DeCastro	Document Production
Pete Guernsey	Project Management/Team Lead, Proposed Action and Alternatives, Natural Gas Resources
Jan Hart	Vegetation, Land Use/Grazing, Soils, Surface Water, TEP&C and BWS Plants
Chris Keefe	Wildlife Resources, TEP&C and BWS Animals, Recreation, Visual Resources
Tamara Keefe	Cartography, GIS
Tamara Linse	Technical Editor
James Lowe	Historic Resources
Lance McNees	Cultural Resources/Historic Resources
Russell Richard	Cultural Resources/Historic Resources
Roger Schoumacher	Quality Assurance
Diane Thomas	Wildlife Resources, Noise/Odor
HydroGeo, Inc.	
Joe Frank	Groundwater and Erosion/Sedimentation Modeling/Surface Water Depletions
Gabrielle Walser	Groundwater and Erosion/Sedimentation Modeling/Surface Water Depletions

Table 6.2. Personnel Contacted or Consulted during Preparation of the Jonah Infill EIS

AGENCY/ORGANIZATION	Individual	Position
Alliance for the Wild Rockies	Michael T. Garity	Executive Director
Banko Petroleum Management	David Banko	President
Barlow & Haun, Inc.	–	–
Big Piney City Government	Dickie Brown	Town Clerk
Biodiversity Conservation Alliance	Jeff Kessler, Erik Molvar	–
BJ Services Company	Dan Dells	District Manager
Bjork, Lindley, Danielson & Little, P.C.	Laura Lindley	Lawyer
BKS Environmental Association Inc.	Terri McGee, Brenda Schladweiler	–
BLM Lands Foundation	G. Early	–
BLM Pinedale Field Office	Priscilla Mecham	Field Manager
BLM Rock Springs Field Office	John McDonald	Soils Specialist
BP America Production Company	Victor Vega	Project Manager
	Dalan D. Haase	Production Engineer
	Kirk Steinle	–
Brother Grimm Trucking	Mike Myers	–
Brown, Drew & Massey, LLP.	Drake D. Hill	–
Casper Star Tribune	Jeff Gearino	–
CAZA Drilling Inc.	Ed Kautz	Vice President
	Toni Schledwitz	General Manager
Center For Native Ecosystems	Erin Robertson	–
Circle Nine Ranch Inc.	Phelps H. Swift, Jr.	–
Defenders of Wildlife	Matt Niemerski	Public Lands Association
	Noah Matson	–
Duke Energy Field Services	Stephen McNair	Vice President
	George Courcier	General Manager Rocky Mountain Region
	Lew D. Hagenlock	–
Encana Oil and Gas (USA) Inc.	Gary R. Gardiner	Vice President Northern Rockies
	John Ricter	Field Supervisor
	Brandy Butler, Cally McKee	–
Energy Analysts	Steve Fillingham	–
Environomics	Eric Williams	–
EOG Resources	C.C. Parsons	Division Operation Manager
Federal Energy Regulatory Commission	L.J. Sauter	–
Feed Barn, Inc.	Kelly F.	–
Frank's Construction	Frank Virden	–
Flaming Gorge PFUSA	Betty Wilkinson	President
Gene R. George & Associates Inc.	Gene R. George	–
Gordon Gregory Photography	Gordon Gregory	–

Table 6.2. (Continued)

AGENCY/ORGANIZATION	Individual	Position
Greater Yellowstone Coalition	Tim Stevens	Issues and Outreach Director
	Lloyd Dorsey	Wyoming Representative
	Scott Groene	–
Gros Venture Investment Co.	Phil Selby	Ranch Manager/Rendezvous Ranch
	Sandra Wright	Manager
Grouse Inc.	Clait E. Braun	–
Hayden-Wing Associates	Larry Hayden-Wing	–
HydroGeo, Inc.	Joe Frank	–
IPAMS	Deena McMullen	Manager of Government and Public Affairs
Jackson Hole Conservation Alliance	Pam Lichtman	Program Director
	Tom Darin	Public Lands Director
JFC	Joe Manatos	–
Johnson County Community College	Rebecca Cramer	Professor
KMG Consulting	Walter D. Lowry	President
Land Water Fund of Rockies	Bruce Driver	Executive Director
Larz Equipment	Brent Larsen	–
Marbleton City Government	Alice Griggs	Town Clerk
Marion County Humane Society	Barbara Warner	Secretary
Monmouth County Audubon Society	Linda Mack	Vice President
Mount Vernon Data Services	Michelle Poolet	President
Mountaintop Consulting, LLC	Robin M. Smith	–
Murdock Land and Livestock Company	–	–
National Park Service	Jere Krakow	–
	Lee Kreutzer	National Trails System
	–	Long Distance Trails Office Superintendent
Natural Resources Conservation Service, Sublette Co. Conservation District, Pinedale Field Office	Carrie Hatch	Water Quality Specialist
	Jennifer Hayward	Resource Conservationist/ GIS
	Ron Reckner	Soil Scientist
Natural Resources Defense Council	Johanna Wald	Senior Attorney
	Craig Dylan Wyatt	–
Nerd Enterprises Inc.	–	–
Office of Federal Land Policy	Lynne Boomgaarden	Director
Office of the Governor	Tracy Williams	Policy Analyst
Oregon-California Trails Association	Dave Welch	National Preservations Officer
Oregon-California Trails Association Preservation Officer	–	–
People for Wyoming	–	Executive Director
	Pat Hickerson	President

Table 6.2. (Continued)

AGENCY/ORGANIZATION	Individual	Position
Petroleum Association of Wyoming	Dru Bower	Vice President
PFUSA	Dorothy Bartholomew	President
	Randy Shipman	President
Pinedale City Government	Rose Skinner	Mayor
	Patti Raisch	Town Clerk
Pinedale Properties	Cyd Goodrich	Realtor
Pinedale Ranger District	Terry Svalberg	Air Quality Specialist
Pittsburg & Midway	Don Lamborn	–
Questar Energy Services	Chris Thornhill	Director of Applied Technology
Questar Gas Management	Dee Findley	–
Williams Energy Services	–	
Rendezvous Ranch & Gros Ventre Cattle Company	Paul Von Gontard	–
Rocky H. Ranch	Bill Phelps	–
Rocky Mountain Energy Reporter	Heather Anderson	Marketing Director
	Gerry Minick	Publisher
Sandy Crossing Enterprises Inc.	Curtis C. Martin	–
Schlumberger Oilfield Services	Cliff McKellar	Field Service Manager
	James Stewart	General Manager
	Vernon Higdon	Field Engineer
	Brandon Jones	Operations Manager
	Brenda Bray	Well Services Manager
	Jesus Espinoza	Field Service Manager
	Jim Cunningham	Bulk Plant Manager
	David G. Morris	–
Shell E&P Company	Aimee Davison	–
SOGO2/TRC Design, Inc.	Susan Goldin	–
South East Environmental Network	Keene Hueftle	Chairman
Southern Colorado AIM	Renee Still Day	Executive Director
Southern Ute Tribal Council	Neil B. Cloud	–
Southwest Wyoming Industrial Association	–	–
Southwest Wyoming Mineral Association	–	–
Steinaker Trucking	–	–
Sublette County Attorney's Office	Marilyn Filkins	County Attorney
Sublette County Courthouse	Mary Lankford	County Clerk
Sublette County Planning Office	–	–
Sublette County Road and Bridge	Dan Holgate	Supervisor
Sublette County Sheriff's Office	Hank Ruland	Sheriff
Surveyor Scherbel, LTD	Paul N. Scherbel	President
Sweetwater County Conservation District	Mary E. Thoman	Chairman

Table 6.2. (Continued)

AGENCY/ORGANIZATION	Individual	Position
Sweetwater County Library	–	–
TALCO Trucking	Aaron McCallister	–
The Wilderness Society	Peter Aengst	Program Director
Ultra Resources	Brian Ault	–
U.S. Air Force	Det Chief	–
U.S. EPA	Cynthia Cody	Director
U.S. Fish and Wildlife Service	Jodi L. Bush	Acting Field Supervisor
	Seedskadee Refuge	Manager
	Brian T. Kelly	Field Supervisor
U.S. Forest Service	Rocky Mountain Region	–
	Carole Hamilton	Forest Supervisor
U.S. Geological Survey	Ann H. Csonka	Environmental Educator
	John M. DeNoyer	Former Associate Director
	Rick Hutchinson	–
U.S. Natural Resources Conservation Office	District Office	–
	Dave Chase, Roger Miller	–
U.S. Natural Resources Conservation Service	–	–
U.S. Representative Barbara Cubin	Bonnie Cannon	Representative
U.S. Senator Mike Enzi	Lyn Shanaghy	Representative
U.S. Senator Craig Thomas	Pati L. Smith	Representative
University at Albany, SUNY	Kenneth P. Able	Professor
University of California Berkley	Luna B. Leopold	Professor of Geology
University of Wyoming	David (Tex) Taylor	Professor of Agriculture Economics
Upper Green River Valley Coalition	Linda Baker	Organizer
Western Wyoming Community College	Achaeological Services	–
Wildlife Management Institute	Len H. Carpenter	Field Representative
	Rollin D. Sparrowe	–
Wind River Environmental Quality Comm.	Don Aragon	Executive Director
Wold Trona	–	–
	Jim Montuoro	–
Wyoming Advocates for Animals	Jeannine R. Stallings	–
Wyoming Department of Agriculture	John Etchepare	Director
Wyoming Department of Environmental Quality	Dan Olson	Air Quality Division Administrator
	John V. Corra	Director
	Rich Vincent	–
Wyoming Department of Revenue	Christie Yurek	Validation Supervisor
Wyoming Department of Transportation	Mark Ayen	Engineer

Table 6.2. (Continued)

AGENCY/ORGANIZATION	Individual	Position
Wyoming Game and Fish Department	Bill Wichers	Deputy Director
Wyoming Game and Fish Department	Dean Clause	Biologist
Wyoming Oil and Gas Commission	Dave Chase	Hydrogeologist
	Roger Miller	Hydrogeologist
Wyoming Outdoor Council	Kelly Matheson	Program Coordinator
	Meridith Taylor	Yellowstone Field Director
Wyoming State Board of Outfitters & Guides	Jane Flagg	–
Wyoming State Historic Preservation Office	Richard L. Currit	State Historic Preservation Officer
Wyoming State Representative	Stan Cooper	–
Wyoming State Senator	Larry Coller	–
	Delaine Roberts	–
Wyoming Wildlife Consultants	John Dahlke	–
Wyoming Wildlife Federation	Cathy Purves	Western Field Director
INDIVIDUALS		
Lani J. Adams	Leslie Van Barselaar	Deniz Bolbol
Steve Agueda	Bryan Bates	Joseph Bolinger
Ken Aho	Fred Baughman	Julie Bond
Jeremy Allen	Jay Beach	Scott Bondegard
Karrin Allen	Eli Bebout	Chris Bookless
Lonnie Allen	Kenny Becker	John Bookless
Matt Allen	David J. Bell	Dan Boudrenault
Rosemary Alles	Tom Bell	Pat Bower
Christina Andersen	William Belveal	Dennis J. Brabec
Martin Andersen	LeeAnn Bennett	Dan Brecht
Neil & Lorna Anderson	R.G. Bennett	Joe Brewer
Robert F. Anderson	Leo Benson	Ned Brewer
Sarah Annarella	Rosemary Benson	Sarah Britt
Jerry Arnold	Kathy Berger	Constance Brizuela
Judy Arnold	Henry Berkowitz	Kenly Brown
Priscilla Atwood	Linda Berkowitz	Vaughn Brown
Joan Bailey	F. Bernolf	Steve Brunelle
Julianne Baker	Michelle J. Biggins	Marlis Brunson
Gene Ball	Norman A. Bishop	Dave Bunning
Joann Bally	Theresa Blair	David Burkhart
Craig Barber	Russel Blalack	Candace Burlingame
David Barnett	Bill Blazich	James Burnett
Peter V. Barrett	Tim Blossom	Barbara Burris

Table 6.2. (Continued)

INDIVIDUALS		
Tom Burns	Andrea Dean	Steve Granada
Corlann Gee Bush	David R. Dean	Stephen M. Greenberg
Robert Byers	Regina Dean	Paul Grover
James Callison	Paul DeBonis	Ravi Grover
Mary Carlson	Michael Deme	Gil Gudmend
Robert D. Carney	Laurie Ann Denison	Tanya Haanpac
Mary Lou Carroll	Danny Dickinson	Caitlin Hakiel
Michael Casey	James Dillon	Joyce L. Harkness
Annette Chaudet	Marilyn Dinger	Denise Harmon
Geneva Chong	Ed Dolinar	Alan Hayes
Scott Christensen	Rita Donham	James Henley
Anna Lee Clark	Nick Downey	Phil Hernandez
Ashley Ann Clark	Larry Downs	Betty Jean Herner
Dallas Clark	Dana L. Dreinhofer	Sanford Higginbotham
Troy Clark	Donald J. Duerr	Ann Hinckley
Duane Claypool	Loretta Dunne	Steve Hitshew
Jim Cleary	Nathan Ebinger	Fernanda E. Hittel
Trish Cleary	Sol Eden	Sarah Hixson
Audry J. Cleland	Kenneth B. Eldridge	Larry D. Honeycutt
Frances M. Cone	Beth Enson	Daryl Hood
John S. Connolly	Dinda Evans	Jim Horner
David Constable	Donald Evans	Brendan Hughes
Patricia Constable	Eric Fairbanks	Guy Hulser
Calvin Cooley	Dale Fefzer	Jeanne Hum
Lonetta Cooley	Carol Finan	William Houghton
Mike Cooney	Casey Fisher	Troy Householder
Linda J. Cooper	James H. Fitch	Chris Jacobs
Esther Cover	D.R. Flock	Leah Jacobs
Jared Cox	Donna Foote	Lisa Jaeger
Lydia Cressall	Dorothy Foster	Anne Jemas
Anthony Criscola	Georgia J. Frazier	Jennifer Jensen
Martie J. Crone	Jeff Frontz	Paul Jensen
Larry Crowell	John Geddie	Roger Jensen
Bill Current	James R. Goddard	Trinni Jensen
Hall Cushman	Ed Golnitz	Debbie Johnson
Jerry Dalton	Tony Goodman	Gordon Johnson
Carl Daly	Machelle Gossett	Bob Johnston
David L. Davidson	Anne Grady	Diana Jones

Table 6.2. (Continued)

INDIVIDUALS		
Kent Jordan	Tami Ingraham Malchow	Maggie Palmer
Les K.	Rich Malone	Jean Palmeter
Angelo Kallas	Lisa Marshall	Mike Partansky
Larry Kaml	Paul Marsing	John Patanelli
Linda Karon	Richard Marsing	Jim Paulsen
Richard Karon	Shannon Marsing	Sally Pederson
Robert L. Kay	Marissa Martin	Larry Pennock
Shari Kearney	Jonathan Mathews	Laveta Pennock
Dennis Keeney	T.J. Mathews	Todd Perry
John Kesich	Lon Mayhew	Lisa Persinger
Brian Kettering	Ellen McCallister	Rodney Peterson
Jacob Kettering	Lillian McCallister	Troy Peterson
James H. King	Tammie McCallister	Clint A. Phillips
Paul Kita	Jenny C. McCune	Brian Pierce
Irene Kitzman	Stuart McKinley	Lynn Pierce
John F. Kohler	Holmes P. McLish	Sandra Pierce
Mark Koplik	Mimi McMillen	David Pitt
Elinore Krell	Stew McMillen	Vern Plentenbery
Corbett Kroehler	Page McNeill	Keith Potter
Roger Kruse	John Meng	Kelly Powers
Jean Kwall	Jennifer S. Miller	Angelina Pryich
Stan Labbe	Neil O. Miller	Stacey Putman
Londa Lamper	Kat Mills	Daron Raines
Laurie Latta	Lonnie Moffitt	Kevin Ramage
Jim Laybourn	Jill Mogen	Paul Rana
Edith Leeper	Kristin Mohney	Jonathan B. Ratner
Daryl LeFevre	Cory Munter	Clem L. Rawlins
Carol J. Levitt	Mike Narramore	Kathy Rebescher
David A. Lien	Debra Nishida	Joseph M. Reichert
Thomas A. Linell	Paul Nordeen	Robin Reinholz
Jim Liskovec	Michael Normington	Jim Von Rembow
Leonard Lovell	Karla Nye	Mark Reneau
Judann Luening	Dave Obenchain	Frank D. Reno
Dave Luxem	Gerald Orcholski	Lavinia Reno
Deb Luxem	Jim Oriet	Stephen A. Reynolds
Matt Lye	Larry Orzechowski	Stephen Reynolds
Audrey Lyke	Jacob L. Overy	Louis D. Rhodes, Jr.
Justin M.	Catherine Palmer	Jake Ribordy

Table 6.2. (Continued)

INDIVIDUALS		
Peggy Sue Richards	Carole Shelby	Jeff Troxel
Nancy Richings	Leslie Sheldon	Sauwah Tsang
Ted Richings	Barbara A. Sherer	Dennis Urbatsch
Matt Ridenour	Roger Sherman	Cat Urbigkit
Austin Rider	Joe Shubert	Jim Urbigkit
Tim Rider	Greg Simcakoski	Daniel R. Vice
Bradley Ridgway	Christopher P. Simms	Tom Volner
Jim Riley	Steve Simon	John Wahl
Dorothy Roberts	Rebecca A. Skinner	Russell Wakefield
Dean M. Roddick	Boyd Smiley	Bucky Walker
Jim R. Rogers	Jeffrey J. Smith	Judith B. Walker
Justin L. Rogers	Mike Smith	Ronald P. Walker
Justin Roghair	Robin Smith	Sunny Walter
Craig Romero	Ruth Smith	A.J. Warner
Donald G. Romero	Ana Yong Soler	Mary Warner
Jamie Rose	Albert Sommers	Billie Watkins
Paul W. Rosenberger	Mario Soto	Sally Weidemann
Dave Rosenfeld	G. Sozio	Fredrick Wen
James H. Ross	Shawn Steed	Janet Westbrook
Kenneth Rouse	Alice Stephens	Howard Weston
Ron Roy	Alta Stephens	Tara Whittaker
Barbara Rugotzke	Edward R. Stewart	James Wilkins
Dean Ruscoe	Jeanne Sugel	Robert E. Williams
Chad Rutherford	Dan Sullivan	David W. Williamson
Robert Rutkowski	Dave Surette	Rachel Winer
Freddy Salgodo	Paul Szymanowski	Lyle Woelich
Shane Sanchez	Nick F. Tabler	Jackie Woods
Justin Santhuff	Thomas Tennyson	Mary Lynn Worl
Todd Sasse	Michael Teply	James Wright
Jim Schaefer	D. Tetre	Bryan Wyberg
Sheron Schaeferle	Duane Thompson	Gretchen Dawn Yost
C.W. Schertz	Brian Thomson	Peter Zadis
Floyd Schneider	Erik Tomasik	John Zickel
Kelvin B. Sellers	Terry Ann Towers	
Bev & Sam Sharp	Michael R. Traq	

Table 6.3. Names and Affiliations (If Known) of Those Who Submitted Written Comments during the DEIS Comment Period from February 11, 2005 through April 12, 2005

AGENCY/ORGANIZATION	Individual
Advantage Resources, Inc.	Edward Ackman
Amerifox Industries, LLC	Gary Byers
ASCG Inc.	Tom Cavanaugh
B&B Oilfield Services	Sean Watts
Baker Hughes, Inc.	John Castetter
Ballard Petroleum Holdings, LLC	Robert Fisher
Bear Cub Energy, LLC	Robert Clark
Bill Barrett Corp	Francis Barron
	Scot Dunato
	Mindy Hollingshead
	Glen Jameson
	Kurt Reinecke
	Troy Schindler
	Donald Sell
	Floyd Wilson
Biodiversity Conservation Alliance	Suzanne Lewis
BP America Production Company	David Brown
Brokerage Southwest	Mary Ellen Painovich
Burns Wall Smith & Mueller, P.C.	Jack Merritts
Cameron, Northern Rockies District	Mark Brown
Caza Drilling	Mike Nuss
	Tom Schledwitz
Center for Native Ecosystems	Erin Robertson
City of Rock Springs	Timothy Kaumo
Dolar Energy LLC	Mark Dolar
Double Eagle Petroleum Co.	D. Steven Degenfelder
Dugan Production Corp.	Thomas Dugan
Dynamic Drilling Fluids, Inc.	Don Williams
Encana	Brandy Butler
EnCana	James Meyers
EnCana	Luke Roberts
Encana	Monte White
EnCana (Rangeland Consultant)	Cotton Bousman
EnCana Oil & Gas (USA)	John Schopp
Envirnmental Protection Agency, Region 8	Robert E. Roberts
Environomics	Eric Williams
EOG Resources, Inc.	Jeane Taylor

Table 6.3. (Continued)

AGENCY/ORGANIZATION	Individual
Equity Brokers GMAC	Ronna Boril
Evergreen Energy	Ryan Buckley
EXCO Resources, Inc.	Dawn Krupp
Fidelity Exploration & Production Company	Vaughn Cox
	Joseph Icenogle
Flaming Gorge PFUSA	Betty Wilkinson
G&E Livestock, Inc.	John Erramouspe
Gene R. George & Associates, Inc.	George Gene
Greater Yellowstone Coalition	Lloyd Dorsey
Greenhalgh, Beckwith, Lemich, Stith & Cannon, P.C.	George Lemich
Hayden-Wing Associates	Larry Hayden-Wing
Helm Energy Company	John Helm
Independent Petroleum Assoc. of Mountain States	Kathleen Eccleston
IPAMS	Andrew Bremner
Iron Creek Energy Group, LLC	Vickie Wenke
J.W. Williams, Inc.	Ben Knox
	Tom Darin
Jackson Hole Conservation Alliance	Tom Darin
Kail Consulting	Carmel Kail
Kerr-McGee Oil & Gas Corp.	Kurt Reisser
Kinder Morgan, Inc.	Greg Bloom
Lesair Environmental, Inc.	Ty Smith
Lewellen Consulting, Inc.	Laura Lewellen
Log Inn Supper Club	Kenneth Henley
Melange International	Gary Stewart
Mountain Petroleum Corp	John Lockridge
Mountaintop Consulting, LLC	Robin Smith
National Wildlife Federation	Michael Saul
Nerd Gas Company LLC	Dennis Brabec
North American Grouse Partnership	James Mosher
Northwest Mining Association	Laura Skaer
Office of State Lands and Investments (WY)	Lynne Boomgaarden
Office of the Governor	Dave Freudenthal
Oxbow Mining LLC	Kenneth Ball
Padco, LLC	Richard Ebener
Patterson-UTI Drilling Company, LP	Doug Rogers
Pechin Engineering	Edgar Pechin

Table 6.3. (Continued)

AGENCY/ORGANIZATION	Individual
Petroleum Association of Wyoming	Dru Bower
Pruitt Gushee	Angela Franklin
Public Lands Advocacy	Claire Moseley
Rat Hole Managers, Inc.	Clark Mortensen
	Dan Mortensen
	Kent Mortensen
	Rick Mortensen
	Rory Mortensen
Rat Hole Managers, Inc.	Bob Pope
	Joe Puckett
Rock Springs City Council	Neil Kourbelas
Rock Springs Grazing Association	John Hay III
Rocky Mountain Region PFUSA	Randy Shipman
Samson Resources	Mark Grummon
Schlumberger Data & Consulting Services	Barbara Luneau
Schlumberger, US Land Western Region	Alex Albert
Shell Exploration & Production Co.	J.R. Justus
Sierra Club – Teton County	Barbara Herz
Sprinkle & Associates, LLC	Stan Sprinkle
State Senator, Sublette/Lincoln/Sweetwater/Uinta	Stan Cooper
Sterling Construction MGT, LLC	Terry Alvord
Sublette County Attorney	Marilyn Filkins
Sublette County Commissioners	Betty Fear
Sweetwater County Commision	Wally Johnson
Sweetwater County Commissioner	Joseph Oldfield
Sweetwater Economic Development Assoc.	Patricia Robbins
Sweetwater Sportsmen for Fish and Wildlife	Eric Adams
The Wilderness Society	Peter C. Aengst
	Janice L. Thomson
Town of Pinedale	Barbara Boyce
	Miriam Carlson
	Nylla Kunard
Trout Unlimited, Public Lands Initiative	David Stalling
Ultra Resources, Inc.	Brian Ault
Upper Green River Valley Coalition	Lauren McKeever
Wellogix, Inc.	Bob Fielding
Western Watershed Project	Jonathan Ratner

Table 6.3. (Continued)

AGENCY/ORGANIZATION	Individual	
White Eagle Exploration	Jane Crouch	
	Marshall Crouch	
Wold Oil	Steve Morzenti	
Wy Dept of Agriculture	John Etchepare	
Wy State Geological Survey	Ronald Surdam	
Wyoming Business Alliance	Bill Murphy	
Wyoming Game & Fish Dept.	Bill Wichers	
Wyoming Legislature	Doug Samuelson	
Wyoming Legislature (House)	Kathleen Davison	
Wyoming Oil & Gas Conservation Commission	Don Likwartz	
Wyoming Outdoor Council	Bruce Pendery	
	Marisa Martin	
Wyoming Wildlife Federation	Cathy Purves	
INDIVIDUALS		
Robert Aarts	Douglas Arcand	Michelle Biggins
Dan Abeyta	Glenn Archer	Ray Blaisdell
Dan Abeyta	Glenn Archer	James Blake
Lynn Abrahamson	Patrick Archer	James Blake
Sharif Abodnage	Edna Arndt	Lynn Bohnet
Armond Acri	Billy Arnett	Gary Bonogafsky
Patty Adair	Bret Atchley	E. K. Bostick
Loren Adams	Jamie Ballard	Pat Boue
Mike Aichele	Stephen Banks	Allen Bourgeois
Guillermo Alatorre	Anita Bartosh	Cotton Bousman
Jose Alatorre	Rick Bates	Roger Bower
Jose Enrique Alatorre	Taner Batmaz	Shelly Brause
Lorenzo Alatorre	Steve Beardsly	Ryan Brause
Manuel Alatorre	Debbie Beaver	Andrew Bremner
Fred Alexander	Jason Belless	Keith Brewer
Adam Allen	Charlotte Belton	Ben Bridges
Frank Amos	Fred Benge	Mary Alice Briggs
Jim Amundson	Fred Benge	Judith Brink
Robert Andersen	Fred Benge	James Broce
Brent Anderson	Ken Berscheit	Bryon Brown
John Anderson	Ken Bersheit	Gary Brown
Ralph Anderson	Terry Bertram	Jason Brown
Stephen V. Anderson, Jr.	Larry Bevans	Mike Brown

Table 6.3. (Continued)

INDIVIDUALS		
Patricia Brown	Dallas Clark	Michael Davis
Cary Brus	J.T. Clark	Andrea Dean
Cal Buckendorf	James Clark	Richard DeFries
Douglas Buckner	Roger Clark	Deven Delap
Mike Buckner	Ron Clark	Devon, Jr Delap
Ben Bulk	Ron Clark	Justin Delap
George Bullington	Ron Clark	Sherril Jo Delap
Stacey Bundy	Ronald Clark	David Dennis
Steve Burch	Ty Clark	Jerry DePoyster
James Burdick	Hershell Clawson	Auden Diaz
James Burgess	Myra Clayton	Larry DiBrito
Kristine Burton-Bacheller	Steve Cluff	Dorian Dietrich
Brandy Butler	William Coble	Scott Dimit
Joe Butner	Michael Cole	Rick Ditton
Gary Byers	Thomas Cole	Christy Doak
Joseph Caddell	Kathy Collins	Normando Dominguez
H. D., Jr Cagle	Kary Colvin	Rita Donham
Davie J. Callahan	Ralph Combs	T.J. Dowley
Dan Campbell	Daniel Coneybeer	Jonathan Downing
Larry Campbell	Lorenzo Contreras	Andre Dub
Sandra Capps	Robert Cooper	Eric Dufek
Joseph Carpenter	Kenny Cooper	Richard Duginski
George Carroll	Nathan Cordle	Sheila Duginski
Kevin Carter	Mario Cortes	Wade Duncan
Roger Carter	Eric Cothern	David Duncan
Charles H. Castor	Boyd Cox	Stephen Dunne
Charles Castor	Darrell Critsek	Andrew Durham
Charles Castor	Julia Crusius	Cory Dutra
Jeffrey Cawsey	Jim Cunningham	David Eldredge
Wayne Cessal	George Danze	Chancy Elkins
Brent Cheeney	Jason Danze	Becky Ellifritz
Sarah Cheezum	Jennifer Danze	John Elliott
Jennifer Chidester	Shane Danze	Patricia Ellis
Michael Christensen	Travis Danze	Bonnie Ellwood
Tera Christoffeese	David Datteri	Edward Elverud
Shane Christopher	Dalis Davis	Scott Ensign

Table 6.3. (Continued)

INDIVIDUALS		
Barbara Erb	Marcus Gailey	Jeffery Halter
Bryan Erickson	Alonso Garcia	Sam Hammers
Byron Erickson	Cindy Gardner	Robert Hammond
Douglas Erickson	Matt Gardner	William Hampton
Joe Erwin	Brian Garduno	Marcy Handley
Liberty Estell	Tim, Jr. Garriott	David Hanks
Al Etcheverry	Thomas Gebes	Evan Hanson
Al Etcheverry	Ray Gentry	James Hardegree
Al Etcheverry	Debbie Gibbs	David Harding
Greg Ethridge	Erin Gibbs	J. Hardman
Jim Etzel	Peter Gilbert	Mary R. Hardy
Trevor Evans	Travis Gines	Paul Harjo
Eric Fairbanks	Jonathan Godfrey	Carol Harkness
Eric Fairbanks	R.J. Goodman	Michael Hart
John Fandek	A.J. Gosar	Carl Hauskjold
Lucy Fandek	Jay Gray	James Hawkey
Scott Farmer	Louis "Duke" Gray	Justin Hawkins
Daryl Farrington	James Green	Sabine Hawkins
Bill Fauber	Mark Green	Alan Hayes
Larry Faulkner	Alice Griggs	Matt Heaton
Jay Fear	Stephen Grimes	Richard Heil
Rusty Feezer	Stephen Grimes	Leslie Henderson
Daniel Ferris	Gary Gross	Jodi Hendricks
Brennon Fica	Gary Gross	Tom Hendricks
Brenda Fisher	Dave Grover	Darrin Henke
Sharie Fisher	Shannon Guffey	Rogelio Hernandez
Vernon Fisher	Jay Gunsch	Jon Herrmann
Dan Fitzloff	Klay Gustin	Ryan Hettinger
Justin Floyd	Matthew Gustin	Jerry Hoch
Terence Ford	James Gutierrez	Ross Hocker
Randy Foster	Macedonio Gutierrez	Ross Hocker
Donnie Franklin	Z. Guzman	Kevin Holdsworth
David Freeman	Paul Hagenstein	Steve Hole
Joe Freeman	Jacqueline Hajba-Miner	Charlotte Hollis
Jade Gaddis	Ryan Hale	Jim Hooks
Thomas Gagnon	Ryan Hale	Chris Hoskins

Table 6.3. (Continued)

INDIVIDUALS		
Tina House	Troy Jones	Dennis Lamoureux
Philip Howland	Troy Jones	Natalie Lane
Clark Huffman	Angelo Kallas	Howard Larsen
Darrin Hughes	John Kappes	Tori Larsen
Mike Hughes	John L. Kappes	Garrick Lawson
Guy Hulsey	Pat Keefe	Jim Laybourn
Roderick Hunter	Pat Keefe	Caleb Leake
Forest Irons	Carlos Keelin	Nicole Ledford
Ben Izatt	Darren Keetch	Brent Lee
Mike Jacobs	Pete Keller	Jerry Lee
Justin Jenkins	Scott Kelley	Tim Lee
Kent Jenkins	Scott Kelley	Charles Leftwich
Mary Jenkins	Bill Kelly	Marlow Lenling
Mary Jenkins	Lonnie Kelly	Juan Leon
Mary Jenkins	Robert Kemp	Thomas Lev
Trinity Jenkins	Ted Kerasote	Michael Leverich
Beth Ann Jennings	Henry Kessel	Douglas Lewis
Clyde Jensen	Henry Kessel	Alfonso Linares
Jennifer Jensen	Donn Kesselheim	Cesar Linares
Jarrol, Sr. Jeppesen	Eric Kester	Francisco Linares
Steve Jerald	Michael Kettle	Mario Linares
Maria Jetkoski	Ronald Kincaid	Nichole Longmire
D.M. Johnson	Jason King	Carlos Lopez
D.M. Johnson	Bret Kingsbury	Carmelo Loredo
Heath Johnson	Kimberly Kirk	Javier Loredo
Shane Johnson	Allan Kirkwood	Terry Lowry
Shawn Johnson	Catherine Kirkwood	John Lusch
Tamara Johnson	Randy Kirkwood	Jimmie Joe Lusk
Glen Johnston	Michael Klein	Jimmie Joe Lusk
J. Thomas Johnston	Jared Klier	Jon Lyman
Bonnie Jolovich	Paul Knapp	Anita MacGill
Brandon Jones	Paul Knapp	Michael Magagna
Mark Jones	Bob Kouri	Michael Magagna
Mark Jones	Arnie Kubischtan	Rodney Mahan
Renee Jones	Dane Kujat	Kerry Mair
Roger Jones	Linda Kulp	Joseph Manatos

Table 6.3. (Continued)

INDIVIDUALS		
Daniel Mapel	Chris Miller	Nick Nichols
Desira Marincic	Neil O. Miller	Nick Nichols
James Markham	Shane Miller	Betty Jo Nicodemus
Rick Marshall	James Mineheine	Lewis Nielsen
Rick Marshall	Vicki Mines	Peter Niper
Neil Martin	Robert Jr. Minor	Daniel Noel
Ramon Jr. Martinez	Shawn Mitchell	Erick Norviel
A. Richard Marx	James Moberly	James Obley
Rich Matlock	Cody Monroe	David O'Connell
Steve Matthew	Julian Morales	Kevin O'Connell
Josh Mauch	Deborah Morley	Floyd Ogle
Nathan McAdams	Dan Morrison	Tami O'Harrow
Jamie McBee	Linda Morrison	Bill Organ
Calvin McDonald	Mary Lou Morrison	Bill Organ
Nancy McDonald	Danny Mortensen	Charlie Ortiz
Paul McDonald	Danny Mortensen	Joaquin Ortiz
Brian McGahey	Mike Mosbey	Jose Ortiz
Clifford McGowan	Echo Mourer	Linda Osborn
Clifford McGowan	John Mullen	Dana Page
Eric McGuire	Cody Mullen	Zack Page
Alice McKeever	John Mullen	Scott Parish
Cliff McKellar	Stephanie Mullen	Ted Parkyn
Loni McKinney	Tillie Mullen	Jacob Paterniti
T. J. McKinzie	Tyler Mullen	Jeff Patterson
Joan McLaren	James Mulvaney	Timothy Pattison
Neil McLaren	William Mumm	Michael Paules
Greg McLaughlin	Larry Murchison	Jim Peay
Cathy McMillen	Brian Myhre	Matthew Peckler
Lance McMillen	David Myhre	Brian Pedersen
Nathen McNutt	Pam Myhre	Sally Pedersen
Kevin Megahey	Brady Nate	R.W. Perotti
Patrick Mehle	Brian Nate	Ben Peterson
Shannon Menard	William Neill	David Peterson
Andy Messier	Lisa Nenna	Dusty Peterson
Josh Meyer	Daniel Newmeyer	David Petrie
George Milatovich	Lora Nichols	Alfess Pew

Table 6.3. (Continued)

INDIVIDUALS		
Tanya Phillips	Suzan Rogers	Blaine Siddoway
Duce Piaia	Donald W. Rogers, Jr.	Jeanne Siegel
Scott Pilch	Kenneth Rose	Matthew Simmons
Stephen Pinter	Monte Rosendahl	Jimmy Sims
Andrew Pitts	Ken Routh	Michael Skinner
Steve Postema	Jim Ruch	Danny Skoriz
Kevin Powers	Raul Saavedra, Jr.	Mike Skrbich
Tony Prater	Raul Saavedra, Jr.	Thomas Sleight
Tony Prater	B. Sachau	Thomas Smart
Darrell Price	Carlos Sagrero	Alyssa Smith
Will Price	Antonio Salazar	Bob Smith
Kevin Prinisle	Jose Salazar	David L., II Smith
Jaime Proa	George Sample	Earl Henry III Smith
Phillip Putnam	Sharon Sample	Jacquelynn Smith
Ty Quickender	Angelica Sanchez	Jake Smith
Callie Quintard	Roberto Sanchez	John Smith
Tucker Quintard	David Sanders	Justin Smith
A. L. Radke	James Sandoval	Justine Smith
Dorothy Radosevich	Mike Sassi	Marc Smith
Bill Rainbolt	Pat Schmid	Ron Smith
Edmundo Flores Rascon	Pat Schmid	Ron Smith
Eddie (Rusty) Ratcliff	Pat Schmid	Terah Smith
Gary Ratti	Tom Schmidt	Terry Smith
Tom Rea	Donald Schramm	Forrest Smonse
Susan Rediger-Blackburn	Jeff Schubert	Neldon Smuin
Steve Reeves	Jill Schultz	Ramiro, III Solis
Lloyd Reints	Denise Schulze	Albert Sommers
Craig Rends	James Scott	Sergio Soria
Stephen Reynolds	Eric Sechrist	Bryan Sowers
Charles Richards	Da-Costa Shado	Elton, Jr. Spotted Horse
C. Warren Richardson	Beverly Sharp	Caryl K. Stafford
Robert Richardson	Larry Shepard	Duane Stafford
John Richter	Mary Ann Sherbrook	Caryl K. Stafford
Jay Roberts	Robin Sherwood	Debra Stanberry
Luke Roberts	Steve Short	Dan Stead
Mark Roberts	Blaine Siddoway	Dana Steffen
Robert Rode.	Blaine Siddoway	Dana Steffen

Table 6.3. (Continued)

INDIVIDUALS		
Troy Stephenson	Jack Trigg	Mark Walsh
Mike Stevens	Stephen Trosclair	Rockey Wasson
Brett Stevenson	Heather Trosclair	Rockey Wasson
Brett Stevenson	Penny Trujillo	Dan Webster
Lloyd Stewart	Robert Trujillo	Derek Weidensee
Monte Stoddard	Mark Turner	Paul Weil
Gerald Stout	Shirley Ulrich	David Weisgerber
Gerald Stout	Joseph Uptain	Mike Welch
Dustin Stringfellow	Gerald Uranker	Devin Westenkow
Robert Strother	Emily Van Engel	Glenn Whicker
Jo Suftko	David VanNorman	Glenn Whicker
Bethany Swank	Troy Vavra	Richard Whicker
Gregory Swann	Arsenio Vega	Zane White
Matt Tarbet	Floro Vega	Ben Whitman
Ed Tardoni	Jose Vega	Fred Wilkie
Rich Tatman	Oswaldo Vega	Allen Williams
Chris Taylor	Michael Vichi	Ronald Wilson
James Telck	Bruce Vincent	Lloyd Winters
Joey Terrill	Patti Vincent	Ward Wise
Eunice Thomas	Frank Virden	Emily Wolffing
Craig Thompson	Mary Viviano	Carolyn Wood
Raymond Thompson	Matt Vogel	Terry Woods
Scott Thompson	Tom Volner	Paddy Workman
Bradley Thoren	Tom Volner	Jamie Wright
Chris Thornhill	Greg Volney	Ron Wright
Chris Thornhill	Greg Volney	Jane Wylie
Chris Thornhill	Michael Vouros	Albert II Yazzie
Chris Thornhill	Morgan Wade	Jamison York
Martin Timmens	Adam Wadman	Tyrell York
Kenneth Tipps	Sharon Wales	Richard Zimmerman
Andrew Tomich	Rich Walker	Jim Zinda
Roger Torgersen	Rich Walker	Robert Zumbrennen
Maria Torres	Ronald Walker	Robert Zumbrennen
Chad Townsend	Scott Walker	Robert Zumbrennen
Cammy Trapp	David Wall	Robert Zumbrennen

Table 6.4. Air Quality-related Comments on the DEIS or Comments on the August 2005 *Draft Air Quality Technical Support Document Supplement* and/or the August 2005 *Air Quality Impact Analysis Supplement* through October 7, 2005

AGENCY/ORGANIZATION	Individual
Biodiversity Conservation Alliance	Suzanne Lewis
Board of County Commissioners, County of Sublette	William W. Cramer
	Betty Fear
	John Linn
BP American Production Company	David Brown
City of Rock Springs	Timothy A. Kaumo, Mayor
EnCana Oil & Gas (USA), Inc.	John Schopp
Environmental Defense	Jana Milford
Environomics, Inc.	Eric Wiliams
First Interstate Bank – Casper Office	Ron J. Pasco
Grand Teton National Park	Susan E. O'Ney
Greater Yellowstone Coalition	Craig Kenworthy
Greenhalgh, Lemich, Stith & Cannon, P.C., Attorneys at Law	George Lemich
Independent Petroleum Association of Mountain States (IPAMS)	Marc W. Smith
Jackson Hole Conservation Alliance	Tom Darin
Petroleum Association of Wyoming	John Robitaille
Questar	C.B. Stanley
Rock Springs Chamber of Commerce	Fran Carrier
Shell Rocky Mountain Production, LLC	J.R. Justus
The Wilderness Society	Peter Aengst
Town of Big Piney	Phil Smith, Mayor
Town of Marbleton	Jim Robinson, Mayor
Town of Jackson, Wyoming	Mark Barron, Mayor
Trout Unlimited	Cathy Purves
Ultra Resources, Inc.	W.R. Picquet
Upper Green River Valley Coalition	Linda Baker
USDA Forest Service - Rocky Mountain & Intermountain Regions	Jeff A. Sorkin
United States Environmental Protection Agency, Region 8	Robert E. Roberts
United States Senate	The Honorable Michael B. Enzi, United States Senator
Western Business Roundtable	Jim Sim
Wyoming Business Alliance, Wyoming Heritage Foundation	Bill Murphy
Wyoming DEQ - Air Quality Division	Darla Potter
Wyoming Department of Environmental Quality	John Corra
Wyoming Outdoor Council	Bruce Pendery
	Vicki Stamper
	Bob Yuhnke
Wyoming Public Radio	Kristin Espeland

Table 6.4. (Continued)

INDIVIDUALS		
Andrew Blair	Amy McReynolds	Stan Swearingen
Eric Fairbanks	Ann Morris	Sharon Wales
Leslie F. Henderson	Burke L. Morin	Bob

CHAPTER 7 — REFERENCES

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CHAPTER 8 — GLOSSARY

abandon: To cease producing oil or gas from a well when it becomes unprofitable. Usually, some of the casing is removed and salvaged, and one or more cement plugs placed in the borehole to prevent migration of fluids between formations.

acre-foot or acre-feet (acre-ft): The volume of water that covers an area of one acre to a depth of one foot (43,560 cubic feet or 325,851 gallons).

ad valorem: Levied according to assessed value.

aeolian: The erosive action of the wind and deposits that are transported by the wind.

affected environment: The resource values potentially affected by the Proposed Action and alternatives analyzed in a NEPA document.

aggregate: Composed of a mixture of substances, separable by mechanical means.

agrillic: Soils rich in clay.

air quality: The properties and degree of purity of air to which people and natural and heritage resources are exposed (National Park Service website <http://www2.nature.nps.gov/air/AQBasics/glossary.htm>).

algal: Of, pertaining to, or composed of algae.

alkaline: Having the quality of a base (pH of 7.0 or greater).

allotment: An area of land where one or more permittees graze their livestock. Generally consists of public land but may include parcels of private or state lands. The number of livestock and season of use are stipulated for each allotment. An allotment may consist of several pastures or be only one pasture.

alluvium: Clay, silt, sand, and gravel or other rock material transported by flowing water and deposited as sorted or semi-sorted sediments.

ambient air: The portion of the atmosphere, external to buildings, to which the public has general access (40 CFR 50).

ambient concentration: The mass of a pollutant in a given volume of air, typically measured as micrograms of pollutant per cubic meter of air.

ambient standards: The absolute maximum level of a pollutant allowed to protect either public health (primary) or welfare (secondary).

ambient: The environment as it exists at the point of measurement and against which changes or impacts are measured.

American Petroleum Institute (API): API is the governing authority on oil industry standards and practices. "API Gravity" is a reference system for the density of crude oils and constituent hydrocarbons.

ancillary facilities: Facilities often required in an oil and gas field other than the wells and pipelines, such as compressor stations.

animal unit month (AUM): The amount of forage necessary to sustain one cow/calf pair for 1 month.

anticline: A geological formation described usually as a dome or inverted saucer. If covered by an impermeable layer of rock, the anticline is a potential oil or gas reservoir.

Application for Permit to Drill (APD): The Department of Interior application permit form to authorize oil and gas drilling activities on federal land or mineral estate.

aquifer: A water-bearing bed or layer of permeable rock, sand, or gravel capable of yielding water.

aquitard: A bed of low permeability adjacent to an aquifer that may serve as a storage unit for groundwater, although it does not readily yield water.

archaeological: The scientific studies of past peoples and cultures by analysis of physical remains (artifacts).

Ardisols: Soils formed in arid climates; they are often dry and have little organic accumulation in the upper layers.

area of critical environmental concern (ACEC): An area on public lands designated for special management to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes or to protect life and safety from natural hazards.

background concentration: The existing levels of air pollutant concentration in a given region. In general, it includes natural and existing emission sources but not future emission sources.

badland: Steep or very steep, commonly non-stony barren land dissected by many intermittent drainage channels. Badland is most common in semi-arid and arid regions where streams are entrenched in soft geologic material. Runoff potential is very high, and geologic erosion is active in such areas.

base property: Lands owned or controlled by the grazing permittee to which a preference number of adjudicated federal livestock AUMs is attached.

bedding material: Any material, often sand, used to prevent rocks in the bottom of the reserve pit from puncturing the synthetic pit liner.

berm: A raised area with vertical or sloping sides.

biodiversity: The variety of plant and animal life on a given area.

borehole: The circular hole made by drilling, extending from the surface to the gas resource to be recovered.

calcareous: Containing calcium carbonate.

Cambic: Soils composed of very fine sand, loamy fine sand, or finer materials.

capability: In the context of the *Standards for Healthy Rangelands for the Public Lands Administered by the Bureau of Land Management in the State of Wyoming*, the highest ecological status a riparian-wetland area can attain given political, social, or economical constraints (i.e., human-caused limiting factors).

casing: Steel pipe placed in an oil or gas well to prevent the hole from collapsing.

cement: Cement is used to "set" casing in the well bore and to seal off unproductive formations and apertures.

collector roads: BLM roads that provide primary access to large blocks of land and connect with, or are extensions of, a public road system.

colluvium: A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity.

commercial reserves: Commercial reserves of oil and gas are restricted to volumes recoverable at an acceptable profitability.

commercial well: A well capable of producing profitably.

completion: The activities and methods to prepare a well for production. Includes installation of equipment for production from an oil or gas well.

condensate (gas condensate): Hydrocarbons (oil) contained in the natural gas stream, often removed by condensation.

conditions of approval (COAs): A set of restrictions, or conditions, included in the approval of a federal permit, including NEPA documents.

conglomerate: Rounded water-worn fragments of rock or pebbles cemented together by another mineral substance.

conglomeratic: Sandstones derived from rounded water-worn fragments of rocks or pebbles.

contrast: The effect of a notable difference in the form, line, color, or texture of the landscape features within the area being viewed.

Controlled Surface Use (CSU): A category of stipulation that allows some use and occupancy of public land while protecting identified resources or values. A CSU stipulation identifies the location protected, activities prohibited or restricted, and the resources protected. The extent of protection may range from a limited area for only one activity to all uses.

corridor: A narrow strip of land.

Council on Environmental Quality (CEQ): An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

Cretaceous era: The latest system of rocks or period of the Mesozoic era, between 136 and 65 million years ago.

criteria pollutants: Air pollutants for which the EPA has established state and national ambient air quality standards. These include particulate matter (PM), nitrogen oxides (NO_X), sulfur dioxide (SO_2), carbon monoxide (CO), and volatile organic compounds (VOCs).

critical elements of the human environment: A list of resource concerns that must be addressed in every NEPA document.

crucial range: Any particular seasonal range or habitat component that has been documented as the determining factor in a population's ability to maintain itself at a certain level over the long-term.

cubic feet per second (cfs): The rate of discharge representing a volume of 1 cubic foot of water passing a given point during 1 second.

cubic foot: The volume of gas contained in one cubic foot of space at a standard pressure base of 14.7 pounds per square inch and a standard temperature base of 60 °F.

cultural resources: The physical remains of human activity (artifacts, ruins, burial mounds, petroglyphs, etc.) and the conceptual content or context (as a setting for legendary, historic, or prehistoric events, such as a sacred area of native peoples, etc.) of an area of prehistoric or historic occupation.

culvert: A drain or conduit often under a road.

cumulative impact: The impact on the environment that 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 taken place over a period of time (40 CFR 1508.7).

cuttings: The material removed from the borehole by the drill bit and lifted to the surface.

decibel: A unit of measurement of noise intensity. The measurements are based on the energy of the sound waves and units are logarithmic. Changes of 5 decibels or more are normally discernible to the human ear.

deciduous: Trees or shrubs that lose their leaves each year during a cold or dry season.

deciview: The unit of measurement of haze developed to uniformly describe levels of monitored and modeled visibility impairment.

delta: An alluvial deposit, usually triangular, at the mouth of a river.

deltaic: Related to or like a delta.

diffusion: A process by which substances are transferred from regions of higher concentrations to regions of lower concentrations (National Park Service website <http://www2.nature.nps.gov/air/AQBasics/glossary.htm>).

directional drilling: The intentional deviation of a wellbore from vertical to reach subsurface areas off to one side from the surface drilling site.

discharge: The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second (cfs), gallons per minute (gpm), or million gallons per day (mgd).

dispersion: The spreading out of pollutants. Generally used to show how much an air pollutant will spread from a particular point.

displacement: As applied to wildlife, forced shifts in the patterns of wildlife use, either in location or timing of use.

disposal well: A well into which produced water from other wells is injected into an underground formation for disposal.

dissolved solids: The total amount of dissolved material, organic and inorganic, contained in water or wastes.

diversity: The distribution and abundance of different plant and animal communities and species.

drainage: Natural channel through which water flows some time of the year. Natural and artificial means for effecting discharge of water as by a system of surface and subsurface passages.

drill rig: The mast, draw works, and attendant surface equipment of a drilling unit.

drilling fluid: Fluid used to lubricate and cool the drill bit, to assist in lifting cuttings from the borehole, and to control pressures in the borehole.

drilling mud: The circulating fluid used to bring cuttings out of the well bore, to cool the drill bit, and to provide hole stability and pressure control. Drilling mud includes a number of additives to maintain the mud at desired viscosities and weights. Some additives that may be used are caustic, toxic, or acidic.

drought: Prolonged dry weather (precipitation less than 75% of average annual amount).

ecosystem: An interacting system of organisms considered together with their environment (e.g., forest, marsh, and stream ecosystems).

effluent: Mixture of oil, gas, water, and sand discharged from a well.

emergent vegetation: Erect, rooted, herbaceous plants that project out of or emerge from the water.

emission factor: An empirically derived mathematical relationship between pollutant emission rate and some characteristic of the source such as volume, area, mass, or process output.

emission: Air pollution discharge into the atmosphere, usually specified by mass per unit time.

endangered species (animal): Any animal species in danger of extinction throughout all or a significant portion of its range. This definition excludes species of insects that the Secretary of the Interior determines to be pests and whose protection under the Endangered Species Act of 1973 would present an overwhelming and overriding risk to man.

endangered species (plant): Species of plants in danger of extinction throughout all or a significant portion of their ranges. Existence may be endangered because of the destruction, drastic change, or severe curtailment of habitat or because of over exploitation, disease, predation, or even unknown reasons. Plant taxa from limited areas (e.g., the type localities only) or from restricted fragile habitats usually are considered endangered.

Entisols: Recently derived soils that show little profile development; formed from river deposits, sand dunes, or recent glacial deposits.

environment: The aggregate of physical, biological, economic, and social factors affecting organisms in an area.

environmental impact statement (EIS): An analysis of alternative actions and their predictable environmental impacts, including physical, biological, economic, and social consequences and their interactions; short- and long-term impacts; and direct, indirect, and cumulative impacts.

Eocene: 1) The next to the oldest of the five major epochs of the Tertiary period in the Cenozoic era. 2) The series of strata deposited during that epoch.

ephemeral drainage: A drainage area or a stream that has no base flow. Water flows for a short time each year but only in direct response to rainfall or snowmelt events.

epicenter: The portion of the earth's surface directly above the focus of an earthquake.

erosion: The removal, detachment, and entrainment of earth materials by weathering, dissolution, abrasion, and corrosion, later to be transported by moving water, wind, gravity, or glaciers.

evaporitic: Sediments that are deposited from aqueous solution as a result of extensive or total evaporation of the solvent.

exploratory well: A well that is drilled to evaluate the gas or oil resources that may be present.

fault: A fracture in bedrock along which there has been vertical and/or horizontal movement caused by differential forces in the earth's crust.

federal lands: All lands and interests in lands owned by the U.S., which are subject to the mineral leasing laws, including mineral resources or mineral estates reserved to the U.S. in the conveyance of a surface or non-mineral estate.

feral: having reverted to the wild state; not domesticated; as in feral (or wild) horses.

field: 1) A set of rocks containing hydrocarbons. 2) An oil and gas reservoir.

flare: Process that burns and evacuates unused gases.

floodplain: That portion of a river valley, adjacent to the channel, which is built of recently deposited sediments and is covered with water when the river overflows its banks at flood stages.

Fluvaquents: Entisols with aquic moisture regimes that occur on floodplains. Usually very deep, somewhat poorly drained soils that have grass-shrub cover.

fluvial: Of or pertaining to rivers.

forage: Vegetation of all forms available for animal consumption.

forb: A broad-leafed flowering herb other than grass.

formation: A rock/mineral deposit or structure covering an area with the same physical properties.

fracing (fracturing): A method of stimulating well production by increasing the permeability of the producing formation. Under extremely high hydraulic pressure, the fracturing fluid (water, oil, dilute hydrochloric acid, or other fluid) is pumped into the formation that parts or fractures it. Proppants or propping agents such as sand or glass beads are pumped into the formation as part of the fracturing job. The proppants become wedged in the open fractures, leaving channels for oil or gas to flow into the well after the hydraulic fracture pressure is released. This process is often called a "frac job." When high concentrations of acid are used, it may be called an "acid frac job."

fugitive dust: Airborne particles emitted from any source other than through a controllable stack or vent.

gathering pipelines: Pipelines within a field that transport gas or oil from the well to a central production facility or to the point of sale.

Global Positioning System (GPS): Computer software that records and stores coordinates for positions on earth via satellite.

grazing preference: The total number of AUMs on public lands apportioned and attached to base property owned or controlled by a permittee, lessee, or an applicant for a permit or lease. Grazing preference holders have a superior or priority position against others for the purpose of receiving a grazing permit or lease. Grazing preference includes active use and use held in suspension.

groundwater: Water contained in the pore spaces of consolidated and unconsolidated material.

grus: An accumulation of angular coarse-grained fragments resulting from the granular disintegration of crystalline rocks (especially granite) generally in an arid or semiarid region.

habitat: A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

habitat function: The arrangement of habitat features and capability of those features to sustain species, population, and diversity of wildlife over time.

Haplaquepts: Fine-loamy soils.

Haplargids: Simple clay like soils (Aridosols). Moderately deep with argillic horizons often having grass-shrub cover.

Haplocalcids: Soils that have a lithic (usually limestone) contact within 50 centimeters of the soil surface.

Haplocambids: Shallow, cambic soils.

Haplosalids: Ardisols that are high in saline content (see playa).

Haplostolls: Coarse, loamy mixed mollisols. Deep dark-colored soils with thick surface layers often having grass-shrub cover.

Holocene: That period of time (epoch) since the last ice age; also the series of strata deposited during that epoch.

human environment: The factors that include but are not limited to biological, physical, social, economic, cultural, and aesthetic factors that interrelate to form the environment.

hydraulic conductivity: The rate of water flow in gallons per day through a cross-section of 1 square foot under a unit hydraulic gradient at the prevailing temperature of 60°F.

hydrocarbon: A compound formed from carbon and hydrogen, for example oil and gas.

hydrology: A science that deals with the properties, distribution, and circulation of surface and subsurface water.

hydrophytic plants: Those species that either require or tolerate wet or saturated soils and are therefore indicative of these conditions.

hydrostatic testing: Testing of the integrity of a newly placed but uncovered pipeline for leaks. The pipeline is filled with water and pressurized to operating pressures, and the pipeline is visually inspected.

impacts: These include a) direct impacts, which are caused by the action and occur at the same time and place and b) indirect impacts, which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect impacts may include growth-inducing impacts and other impacts related to induced changes in the pattern of land use, population density, or growth rate and related impacts on air and water and other natural systems, including ecosystems. Impacts include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Impacts may also include those resulting from actions which may have both beneficial and detrimental impacts, even if on balance the agency believes that the impact will be beneficial (40 CFR 1508.8).

impermeable: Not permitting the passage of a fluid.

impoundment: The accumulation of any form of water in a reservoir or other storage area.

increment: Incremental standards (prevention of significant deterioration [PSD]) are the maximum amounts of pollutants allowed above the baseline in regions of clean air.

infiltration: The movement of water or some other liquid into the soil or rock through pores or other openings.

infrastructure: The basic framework or underlying foundation of a community including road networks, electric and gas distribution, water and sanitation services, and facilities.

injection well: A well that is used to inject produced water from drilling operations in order to maintain pressure or to bring a field back under pressure.

interdisciplinary team (IDT): A group of federal and cooperating agencies selected to work within the NEPA process in scoping, analysis, and document preparation. The purpose of the team is to integrate its collective knowledge of the physical, biological, economic, and social sciences and the environmental design arts into the environmental analysis process. Interaction among team members often provides insight that otherwise would not be apparent.

interim reclamation: Reclamation initiated on well pads, roads, and pipelines after drilling activity is completed and wells are in production. Interim reclamation is considered successful when reclamation performance objectives are met.

intermittent stream: A stream or reach of a stream that is below the local water table for at least some part of the year and obtains its flow from both surface runoff and groundwater discharge.

intertonguing: Irregular/overlapping boundaries among rock formations.

irretrievable: A term that applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.

irreversible: A term that describes the loss of future options. Applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over long periods of time.

lacustrine: Pertaining to, produced by, or formed in a lake or lakes.

land use: The types of activities allowed (e.g., mining, agriculture, timber production, residential, industrial).

landslide: A perceptible downhill sliding or falling of a mass of soil and rock lubricated by moisture or snow.

leaching: To cause a liquid to percolate through something.

lease: 1) A legal document that conveys to an operator the right to drill for oil and gas. 2) The tract of land on which a lease has been obtained, where producing wells and production equipment are located.

lek: A traditional courtship display attended by male greater sage-grouse in or adjacent to sagebrush-dominated habitat. Leks are categorized as:

> **Active -** Any lek that has been attended by male greater sage-grouse during the strutting season.
>
> **Inactive -** Leks where it is known that there was no strutting activity through the course of a strutting season.
>
> **Unknown -** Leks that have not been documented either active or inactive during the course of a strutting season.
>
> **Occupied -** A lek that has been active during at least one strutting season within the last 10 years.
>
> **Unoccupied (formerly termed "historical lek") -** There are two types of unoccupied leks: (1) Destroyed - a formerly active lek site and surrounding sagebrush habitat that has been destroyed and is no longer capable of supporting greater sage-grouse breeding

activity. (2) Abandoned - a lek in otherwise suitable habitat that has not been active during a consecutive 10-year period.

Undetermined - Any lek that has not been documented as being active in the last 10 years but that does not have sufficient documentation to be designated unoccupied.

life-of-project (LOP): Begins with the first disturbance authorized under the ROD for this project and ends when all wells are plugged and abandoned and all surface disturbance (each disturbed site) meets the reclamation performance objectives.

lithic scatter: A surface scatter of cultural artifacts and debris that consists entirely of lithic (i.e., stone) tools and chipped stone debris. This is a common prehistoric site type that is contrasted to a cultural material scatter (which contains other or additional artifact types such as pottery or bone artifacts), or to a camp (which contains habitation features, such as hearths, storage features, or occupation features), or to other site types that contain different artifacts or features.

lithology: The description of the physical character of a rock as determined by eye or with a low-powered magnifier, based on color, structures, mineralogic components, and grain size.

loam: A mixture of sand, silt, and clay containing between 7% and 27% clay, 28% to 50% silt and less than 50% sand.

local roads: BLM roads that provide primary access to large blocks of land and connect with or are extensions of a public road system.

log: A systematic recording of data, as from the driller's log, mud log, electrical well log, or radioactivity log. Many different logs may be run to obtain various characteristics of downhole formations.

long-term impacts: For the purpose of this NEPA analysis, long-term impacts last for the life of the project or beyond.

migrate: To pass periodically from one region or climate to another.

mineral rights: Reserved mineral rights are the retention of ownership of all or part of the mineral rights by a person or party conveying land to the United States. Conditions for exercising these rights have been defined in the Secretary's *Rules and Regulations to Govern Exercising of Mineral Rights Reserved in Conveyances to the United States* attached to and made a part of deeds reserving mineral rights.

mitigate: To lessen the severity.

mitigation measures: Actions taken to reduce or minimize potential impacts to the environment.

mitigation: Avoiding the impact altogether by not taking a certain action or parts of an action; minimizing impacts by limiting the degree of magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and/or compensating for the impact by replacing or providing substitute resources or environments.

modeling: A mathematical or physical representation of an observable situation. In air pollution control, models afford the ability to predict pollutant distribution or dispersion from identified sources for specified weather conditions.

Modified Mercalli (MM) Intensity Scale of 1931: A scale designed to describe the effects of an earthquake, at a given place, on natural features, on industrial installations, and on human beings.

Mollisols: Soil order that has a thick (generally 10-inch), very dark brown to black surface horizon that is rich in organic matter (grassland soils common in prairie regions).

monitor: To systematically and repeatedly watch, observe, or measure environmental conditions in order to track changes.

mud: Mud is drilling fluid that consists mainly of a mixture of water, or oil distillate, and "heavy" minerals such as bentonite or barites.

mud system: A system used to manage suspended mud in the well-drilling process.

National Ambient Air Quality Standards (NAAQS): The allowable concentrations of air pollutants in the air specified by the federal government. The air quality standards are divided into primary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public health) and secondary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public welfare from any unknown or expected adverse effects of air pollutants).

National Environmental Policy Act of 1969 (NEPA): The federal law established in 1969, which went into effect on January 1, 1970, that 1) established a national policy for the environment, 2) requires federal agencies to become aware of the environmental ramifications of their proposed actions, 3) requires full disclosure to the public of proposed federal actions and a mechanism for pubic input into the federal decision-making process, and 4) requires federal agencies to prepare an environmental impact statement for every major action that would significantly affect the quality of the human environment.

National Register of Historic Places: A list of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture.

native species: Plants or animals that originated in the area in which they are found (i.e., they naturally occur in that area); with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

Natrargids: Soils with a clay accumulation horizon and alkali (sodium) accumulation.

natural gas: Those hydrocarbons, other than oil and other than natural gas liquids separated from natural gas, that occur naturally in the gaseous phase in the reservoir and are produced and recovered at the wellhead in gaseous form.

No Action Alternative: The management direction, activities, outputs, and effects that are likely to exist in the future if the current plan would continue unchanged.

No Surface Occupancy (NSO): A stipulation in a lease that disallows any surface disturbance in the lease area at any time. Natural gas or oil from an NSO area, for instance, would have to be recovered by directional drilling.

Notice of Intent (NOI): A notice published in the *Federal Register* to announce the intent to prepare an EIS.

noxious weeds: Officially designated (State of Wyoming-designated, Sublette County-declared) undesirable or invading weedy species generally introduced into an area due to human activity.

oil and gas field: A natural accumulation of oil and gas in the subsurface. Oil and gas may be present in two or more reservoirs at different depths.

oil and gas lease: A federal oil and gas lease is a legal document that gives the lease holder the right to explore for and develop any oil and gas that may be present under the area designated in the lease while complying with any surface use conditions which may have been stipulated when the lease was issued.

ozone (O_3): A molecule containing three oxygen atoms produced by passage of an electrical spark through air or oxygen (O_2).

paleontology: The science that deals with the history and evolution of life on earth.

particulate matter: A particle of soil or liquid matter (e.g., soot, dust, aerosols, fumes, and mist).

passerine: Passerines are the perching birds, and most are also songbirds.

paraglacial: Refers to glacier-related processes and phenomena such as soil deposition and lake formation.

perennial stream: A stream or reach of a stream that flows throughout the year.

perforation: Holes punched in the casing of a well at the pay zone to be produced to allow gas or oil to enter the well.

permeability: The extent that a substance is open to passage or penetration, especially by fluids.

permeable: The property or capacity of a porous rock, sediment, or soil to transmit a liquid.

permittee (grazing): A person who has livestock grazing privileges on an allotment or allotments within the resource area.

physiographic province: A region having a pattern of relief features or landforms that differs significantly from adjacent regions.

physiographic: Pertaining to the genesis and evolution of landforms.

playa: The shallow central basin of a desert plain in which water gathers and is evaporated.

Pleistocene: Pertaining to the geologic epoch forming the earlier half of the Quaternary Period, characterized by the advent of modern humans.

PM_{10}: Airborne suspended particles with an aerodynamic diameter of 10 microns or less.

$PM_{2.5}$: Airborne suspended particles with an aerodynamic diameter of 2.5 microns or less.

potential: In the context of the *Standards for Healthy Rangelands for the Public Lands Administered by the Bureau of Land Management in the State of Wyoming*, the highest ecological status a riparian-wetland area can attain given no political, social, or economical constraints.

potentiometric surface: An imaginary surface that represents the static head of groundwater and is defined by the level to which water will rise.

preferred alternative: The alternative identified in the EIS as the action favored by the agency.

prevention of significant deterioration (PSD): A classification established to preserve, protect, and enhance the air quality in National Wilderness Preservation System areas in existence prior to August 1977 and other areas of national significance, while ensuring economic growth can occur in a manner consistent with the preservation of existing clean air resources. Specific emission limitations and other measures, by class, are detailed in the Clean Air Act (42 U.S.C. 1875 et seq.).

produced water: Water brought to the surface through the borehole.

production casing: Steel pipe installed in the borehole to isolate formations in the borehole and to eliminate communication among hydrocarbon-bearing zones and/or water aquifers and other mineral resources.

production: Phase of commercial operation of an oil field.

proppants: Proppants or propping agents are substances such as sand or glass beads that are pumped into the formation as part of the fracturing job. The proppants become wedged in the open fractures, leaving channels for oil to flow into the well after the hydraulic fracture pressure is released. This process is often called a "frac job." When high concentrations of acid are used, it may be called an "acid frac job" (see also fracing/fracturing).

PSD increments: The maximum allowable increase in pollutant concentrations permitted over baseline conditions as specified in the EPA Prevention of Significant Deterioration (PSD) regulations (40 CFR Part 52.21). The regulations apply only to areas currently attaining NAAQS/WAAQS. Most National Parks and Wilderness Areas are Class I areas, where almost no future pollution increase is permitted. Most other areas are Class II areas, where moderate increases in pollution levels are allowed.

public land: Lands or interests in lands owned by the United States and in this case administered by the Secretary of Interior through the Bureau of Land Management, without regard to how the United States acquired ownership.

quaternary: The latest period of time, from the present to 2 million years ago and represented by local accumulations of glacial and post-glacial deposits.

range: Land producing native forage for animal consumption and lands that are revegetated naturally or artificially to provide forage cover that is managed like native vegetation, that are amenable to certain range management principles or practices.

raptor: A group of carnivorous birds consisting of hawks, eagles, falcons, kites, vultures, and owls.

recharge: Replenishment of the water supply in an aquifer through the outcrop or along fracture lines.

reclamation: Rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves regrading, replacement of topsoil, revegetation, and other work necessary to restore it for use.

Record of Decision (ROD): A decision document for an EIS or Supplemental EIS that publicly and officially discloses the responsible official's decision regarding the actions proposed in the EIS and their implementation.

reserve pit: An excavated pit that may be lined with plastic that holds drill cuttings and waste mud.

reserves/recoverable reserves: Areas of mineral-bearing rock from which the mineral can be extracted profitably with existing technology and under present economic conditions.

reservoir: The "pool" of oil or gas that is being tapped.

residuum: Something remaining after removal of a part; a residue.

resource roads: Spur roads that provide point access, as to a well site, and connect to local or collector roads.

revegetation: The reestablishment and development of self-sustaining plant cover. On disturbed sites, human assistance will speed natural processes by seedbed preparation, reseeding, and mulching.

rig: A collective term to describe the equipment needed when drilling a well.

right-of-way (ROW): The legal right for use, occupancy, or access across land or water areas for a specified purpose or purposes.

riparian: Land areas which are directly influenced by water. They usually have visible vegetative or physical characteristics showing this water influence. Streamsides and lake borders are typical riparian areas.

roosting: To rest or sleep in a roost. A bird will typically use the same roost for an extended period of time.

runoff: That part of precipitation that appears in surface streams. Precipitation that is not retained on the site where it falls and is not absorbed by the soil.

salinity: 1) A measure of the amount of mineral substances dissolved in water; 2) salty.

scatter (archeological): Archaeological evidence of prior disturbance that is distributed about an area rather than concentrated in a single location.

scope: Extent or range of view.

scoping: An early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action. Scoping may involve public meetings, field interviews with representatives of agencies and interest groups, discussions with resource specialists and managers, and written comments in response to news releases, direct mailings, and articles about the proposed action and scoping meetings.

sediment: Soil or mineral transported by moving water, wind, gravity, or glaciers, and deposited in streams or other bodies of water or on land.

sediment load: The amount of sediment (sand, silt, and fine particles) carried by a stream or river.

seismic: Pertaining to an earthquake or earth vibration, including those that are artificially induced.

shale: A laminated sediment in which the constituent particles are predominantly of the clay grade.

short-term impacts: For the purpose of this analysis, short-term impacts are generally defined as those that would last for 5 years or less.

shrink-swell: Refers to clays or soils that alternately expand and contract in a semiarid climate where drying out is possible.

shut-in: The process of stopping production at an otherwise producing well.

significant impact: A meaningful standard to which an action may impact the environment. The impact may be beneficial, adverse, direct, indirect, or cumulative and may be short-term or long-term.

silt: Any earthy material composed of fine particles, smaller than sand but larger than clay, suspended in or deposited by water.

site-specific environmental assessments: Environmental assessments generally completed for small projects such as individual wells, designed to address issues associated with small projects, and generally under the guidance of a more comprehensive NEPA document.

slope wash: Soil and rock material that is being or has been moved down a slope predominantly by the action of gravity assisted by running water that is not concentrated into channels.

socioeconomics: Study of an impact region on the current and projected population and relative demographic characteristics (housing, economy, government, etc.).

soil productivity: The capacity of a soil to produce a specific crop such as fiber and forage, under defined levels of management. It is generally dependent on available soil moisture, nutrients, and length of growing season.

spacing: The number of acres per given well in the subsurface. For instance, 160-acre spacing means that one well would be drilled in each quarter section (160 acres) or up to four wells per section (640 acres).

special management area: An area to which a given management objective and prescriptions are applied.

species of concern: Species of concern include federally listed threatened or endangered species, species proposed for listing, BLM sensitive species, WGFD priority species, and species considered rare or important by the Wyoming Natural Diversity Database.

stipulation: A legal requirement, specifically a requirement that is part of the terms of a mineral lease. Some stipulations are standard on all federal leases. Other stipulations may be applied to the lease at the discretion of the surface management agency to protect valuable surface resources. Stipulations are supported by the NEPA process; without NEPA support, a stipulation cannot be added to the lease.

strata: An identifiable layer of bedrock or sediment.

structural basin: A large depression of structural origin.

substrate: Material consisting of silts, sands, gravels, boulders, and/or woody debris found on the bottom of a stream channel.

surface disruptive (human) activities: The physical presence, sounds, and movements of people and their activities that are likely to cause displacement of or excessive stress to wildlife during critical life stages (breeding, nesting, birthing) or during periods of severe winter weather conditions. Examples of disruptive activities include noise, traffic, or human presence regardless of the purpose of the activity. Stipulations to mitigate disruptive activities can be absolute or timing-based.

surface disturbing activities: Any authorized action that disturbs vegetation and surface soil, increasing erosion potential above normal site conditions. This definition typically applies to mechanized or mechanical disturbance. However, intense or extensive use of hand or motorized hand tools may fall under this definition. Examples of surface disturbing activities include construction of well pads and roads, pits and reservoirs, pipelines and power lines, mining, and vegetation treatments.

synclinal axis: The axis of a fold where the youngest rocks are in the interior of the fold.

Tertiary: The older of the two geologic periods comprising the Cenozoic Era; also the system of strata deposited during that period.

threatened species: Any species (plant or animal) that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.

thrust fault: A low angle fault in which the rocks above the fault plane move up relative to the rocks below. The rocks that move up are the thrust sheet.

topographic basin: A large depression of erosional origin.

topography: The features of the earth, including relief, vegetation, and waters.

topsoil: The uppermost layers of naturally occurring soils suitable for use as a plant growth medium.

Torrispamments: Sandy soils in arid regions, soils associated with sandy uplands. Very deep soils often having a grass-shrub cover.

total dissolved solids (TDS): Total amount of dissolved material, organic or inorganic, contained in a sample of water.

Total Energy Efficiency (TEE): A measurement of energy efficiency that takes into account all energy used or lost in the production, processing, and delivery steps involved in supplying energy to the user, plus the efficiency of the energy-using product itself.

transpiration: The process by which water vapor escapes from a living plant and enters the atmosphere.

tuff(aceous): A rock formed by compacted volcanic fragments, generally smaller than 4 mm in diameter.

turbidity: A measurement of the total suspended solids.

two-track: A road that has not been constructed or maintained but that has been created by repeated use.

typic: In soil taxonomy, the typical, or central, concept of a "great group," one of six categories used to classify soils (order, suborder, great group, subgroup, family, and series). "Typic" is considered a "subgroup" in this hierarchy.

unconformity: A break in the stratigraphic sequence.

understory: A layer of vegetation underlying a layer of taller vegetation, such as brush and grass under trees.

undulate: To move or cause to move with a wavelike motion.

ustic: Soils that are moist for more than half a year but have a distinct dry season.

vegetation type: A plant community with visually distinguishable characteristics, named for the apparent dominant species.

viewshed: The areas seen from any given point.

visibility: Refers to the visual quality of the view or scene in daylight, with respect to color, rendition, and contrast definition. The ability to perceive form, color, and texture.

visual range: The distance at which a black object just disappears from view.

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 Management (VRM): A system of visual management used by the BLM. The program has a dual purpose—to manage the quality of the visual environment, and to reduce the visual impact of development activities while maintaining effectiveness in all BLM resource programs. VRM also identifies scenic areas that warrant protection through special management attention. The system uses four classes for categorizing visual resources.

> **Class I -** Natural ecological changes and limited management activity are allowed. Any contrasts created within the characteristic landscape must not attract attention. This classification is applied to wilderness areas, wild and scenic rivers, and other similar situations.

Class II - Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the characteristic landscape. Contrasts are seen but must not attract attention.

Class III - Contrasts to the basic elements caused by a management activity are evident but should remain subordinate to the existing landscape.

Class IV - Any contrast may attract attention and be a dominant feature of the landscape in terms of scale, but it should repeat the form, line, color, and texture of the characteristic landscape.

water bar: A ridge made across an incline to divert water to one side.

water quality: Refers to a set of chemical, physical, or biological characteristics that describe the condition of a river, stream, or lake. The quality of water determines what beneficial uses it can support. Different conditions or levels of water quality are required to support different beneficial uses.

water recharge: The natural process whereby surface water enters a groundwater aquifer.

watershed: The total land area that drains to a given watercourse or body of water.

watershed (6th level): The watershed and subwatershed hydrologic unit boundaries provide a uniquely identified and uniform method of subdividing large drainage areas. The smaller-sized level sub-watersheds (up to 250,000 acres) are useful for application programs.

Waters of the U.S.: A jurisdictional term from Section 404 of the Clean Water Act referring to water bodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds with defined bed and bank, the use, degradation, or destruction of which could affect interstate or foreign commerce.

well or wellbore: The hole drilled from the surface to the gas-bearing formation, several of which may be developed from a single well pad.

well pad: Relatively flat work area (surface location) that is used for drilling a well or wells and producing from the well once it is completed.

wetlands: Areas that are inundated by surface water or groundwater with a frequency sufficient to support—and under normal circumstances do or would support—a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

wind rose: Any one of a class of diagrams designed to illustrate the distribution of wind direction experienced at a given location over a given period of time. Wind roses may also give information concerning distribution of wind speed, stability, or other meteorological parameters.

winter range: The place where migratory (and sometimes non-migratory) animals congregate during the winter season.

workover: Well maintenance activities that require onsite mobilization of a drill rig to repair the well bore equipment (casing, tubing, rods, or pumps) or the wellhead. In some cases, a workover may involve development activities to improve production from the target formation.

Wyoming Ambient Air Quality Standards (WAAQS): The allowable concentrations of air pollutants in the air specified by the State of Wyoming. The air quality standards are divided into primary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public health) and secondary standards (based on the air quality criteria and allowing an adequate margin of safety and requisite to protect the public welfare from any unknown or expected adverse effects of air pollutants).

zone: The area between two depths in a well containing reservoir or other characteristic.