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

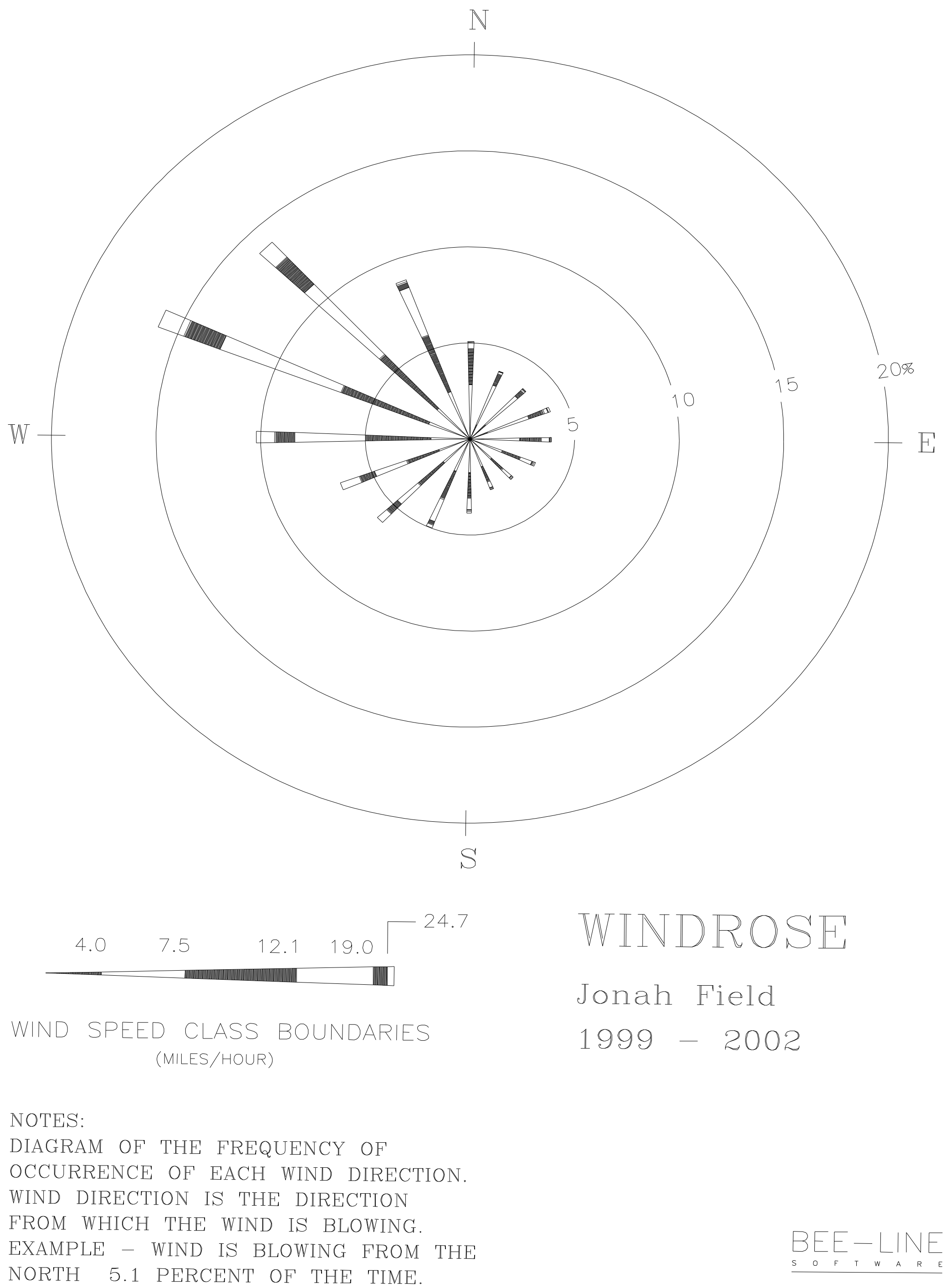
[1] Source: BP America (2004).

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

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.

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

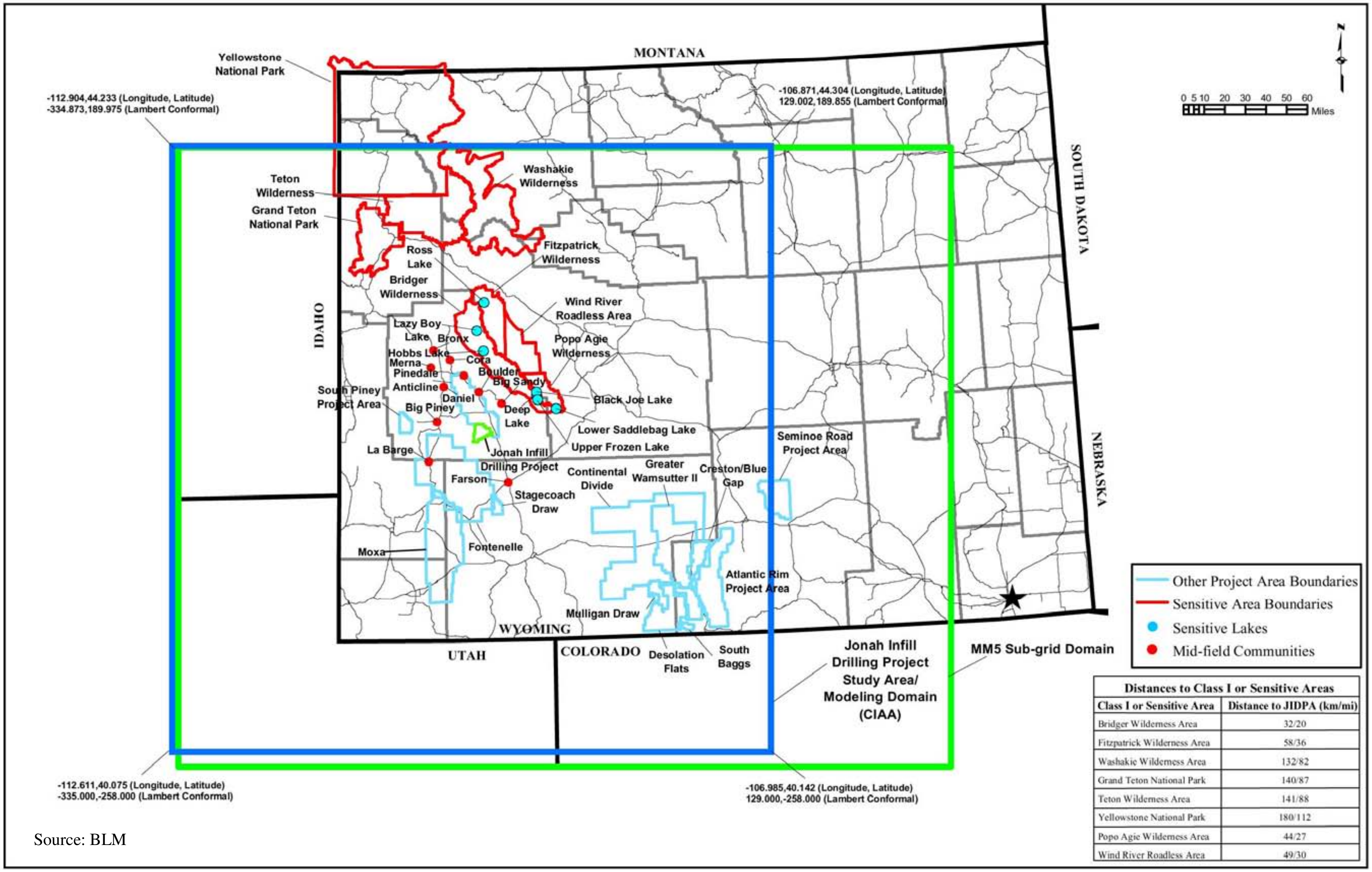
Class[2]	Frequency (%)
A	2.3
B	5.9
C	12.0
D	60.8
E	15.2
F	3.7

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

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/m³)

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.

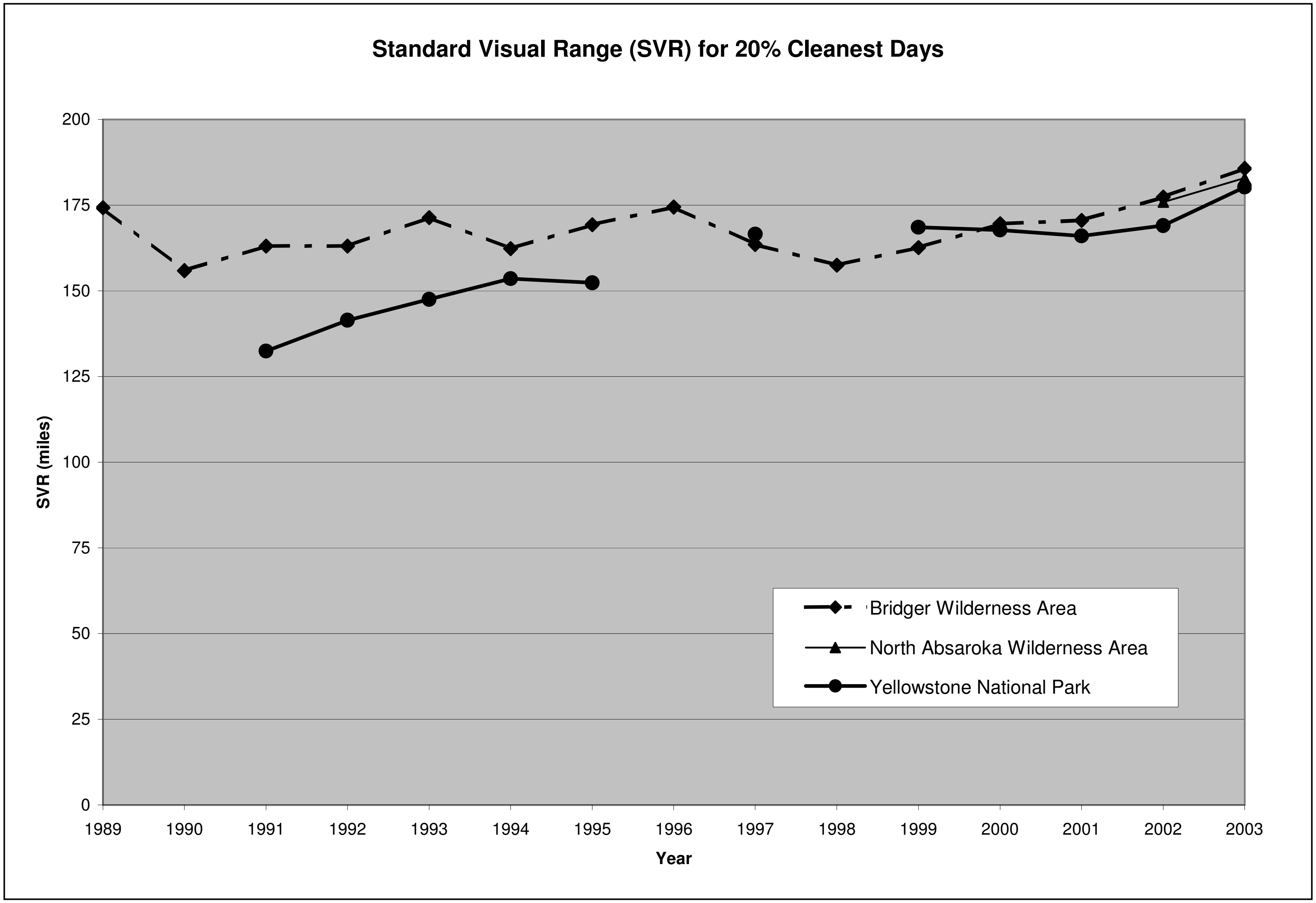
The Bridger Wilderness Area, North Absaroka Wilderness Area, and Yellowstone National Park IMPROVE sites are the closest such sites to the JIDPA. Data have been collected near the Bridger Wilderness Area and Yellowstone National Park sites since 1989, and at the North Absaroka Wilderness Area since 2000. 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.

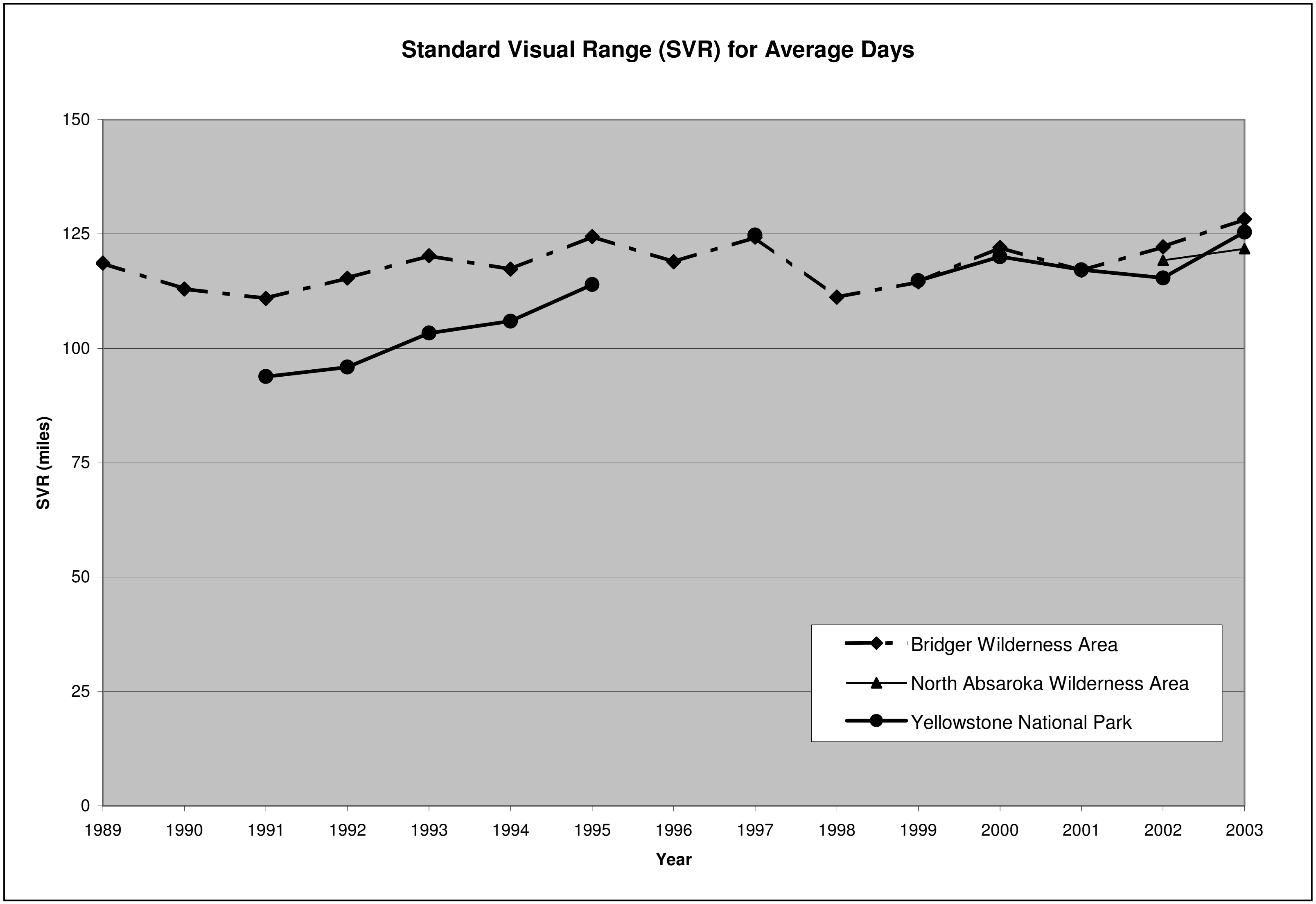
Total deposition levels of concern (LOC) have been estimated for several areas, including the Bridger Wilderness Area (U.S. Forest Service [USFS] 1989). The “red line” LOC represents an estimate of the total pollutant loadings that each wilderness can tolerate. Total loadings above these values suggest 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.



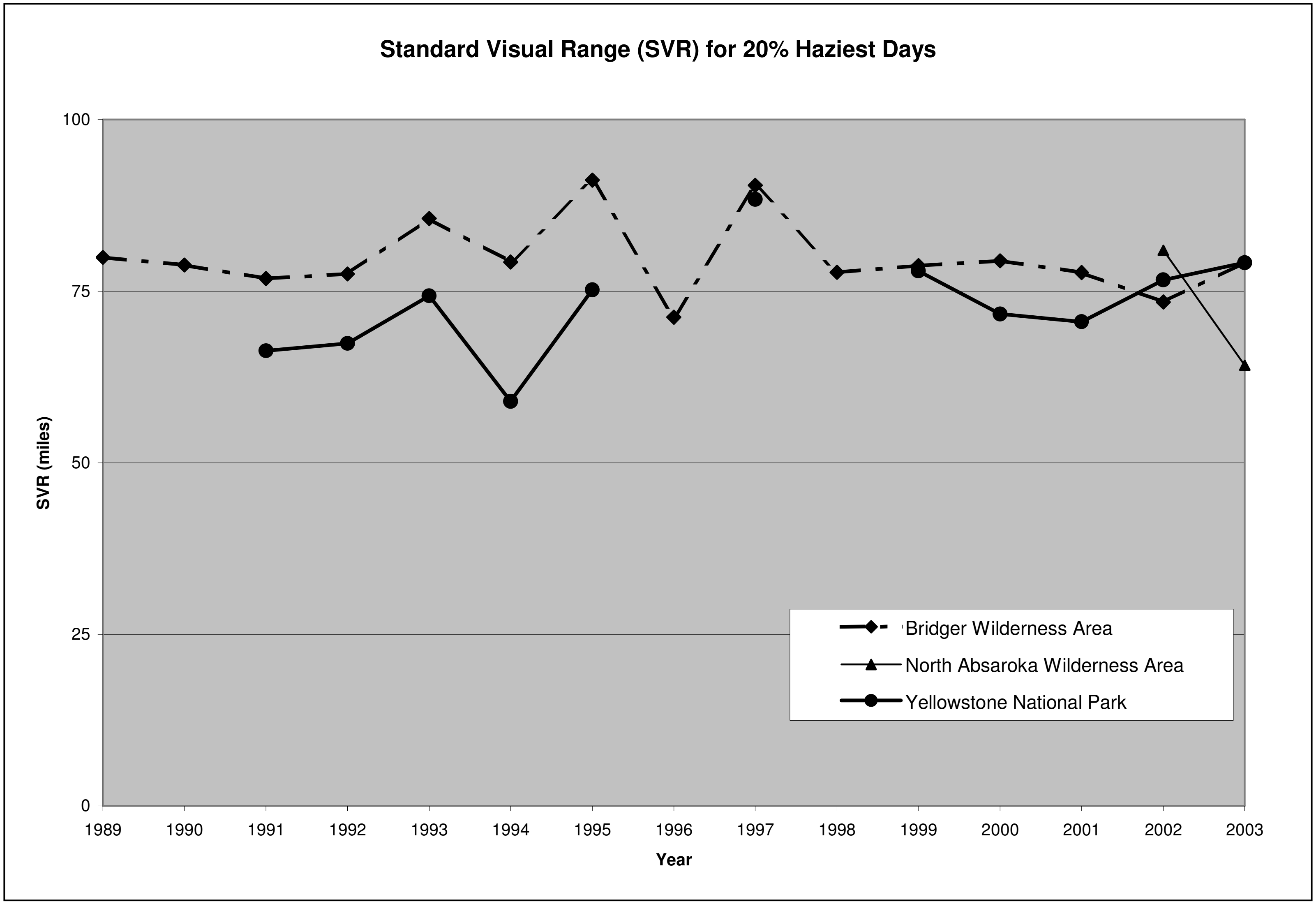
Source: IMPROVE (2005)

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



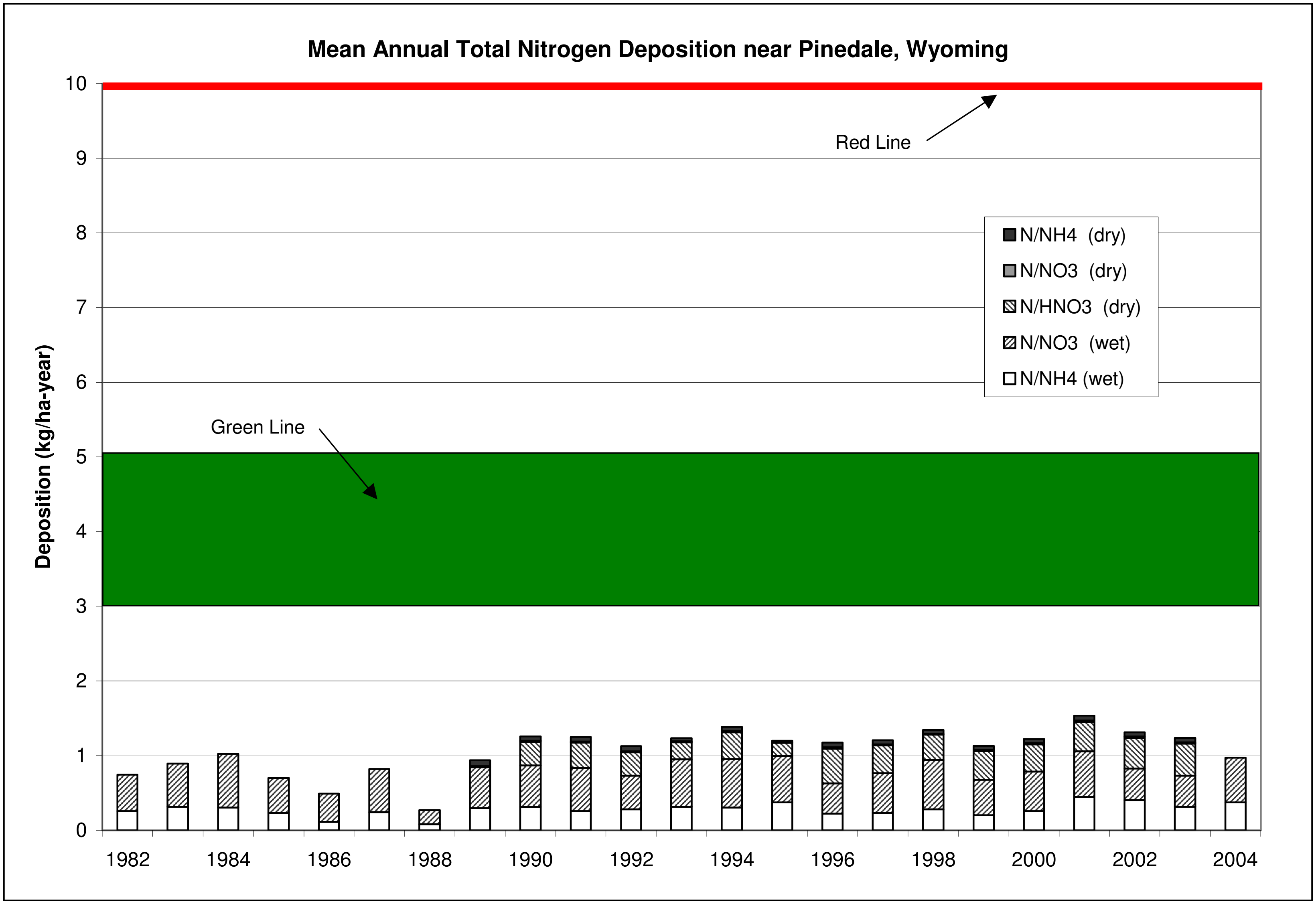
Source: IMPROVE (2005)

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



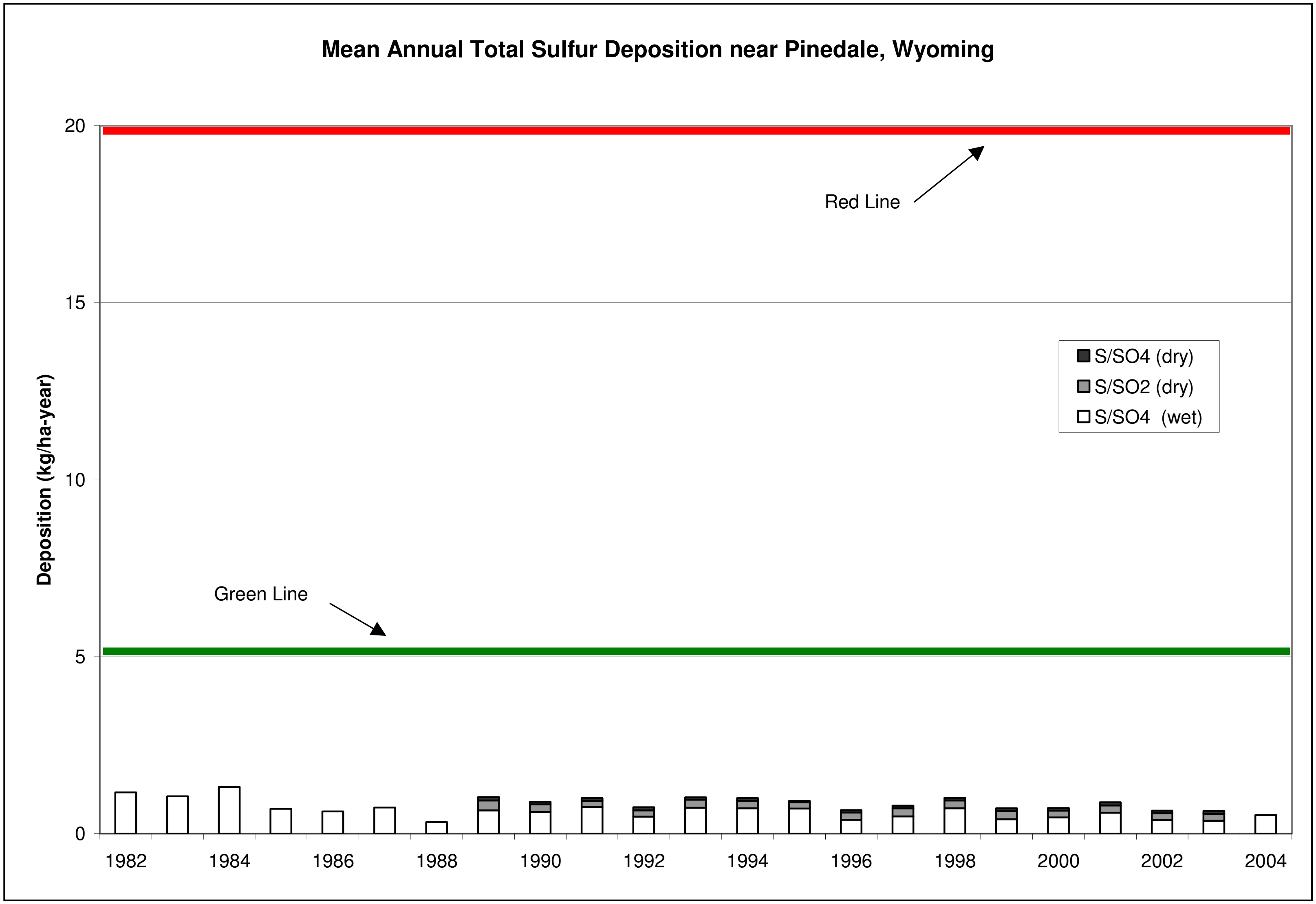
Source: IMPROVE (2005)

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



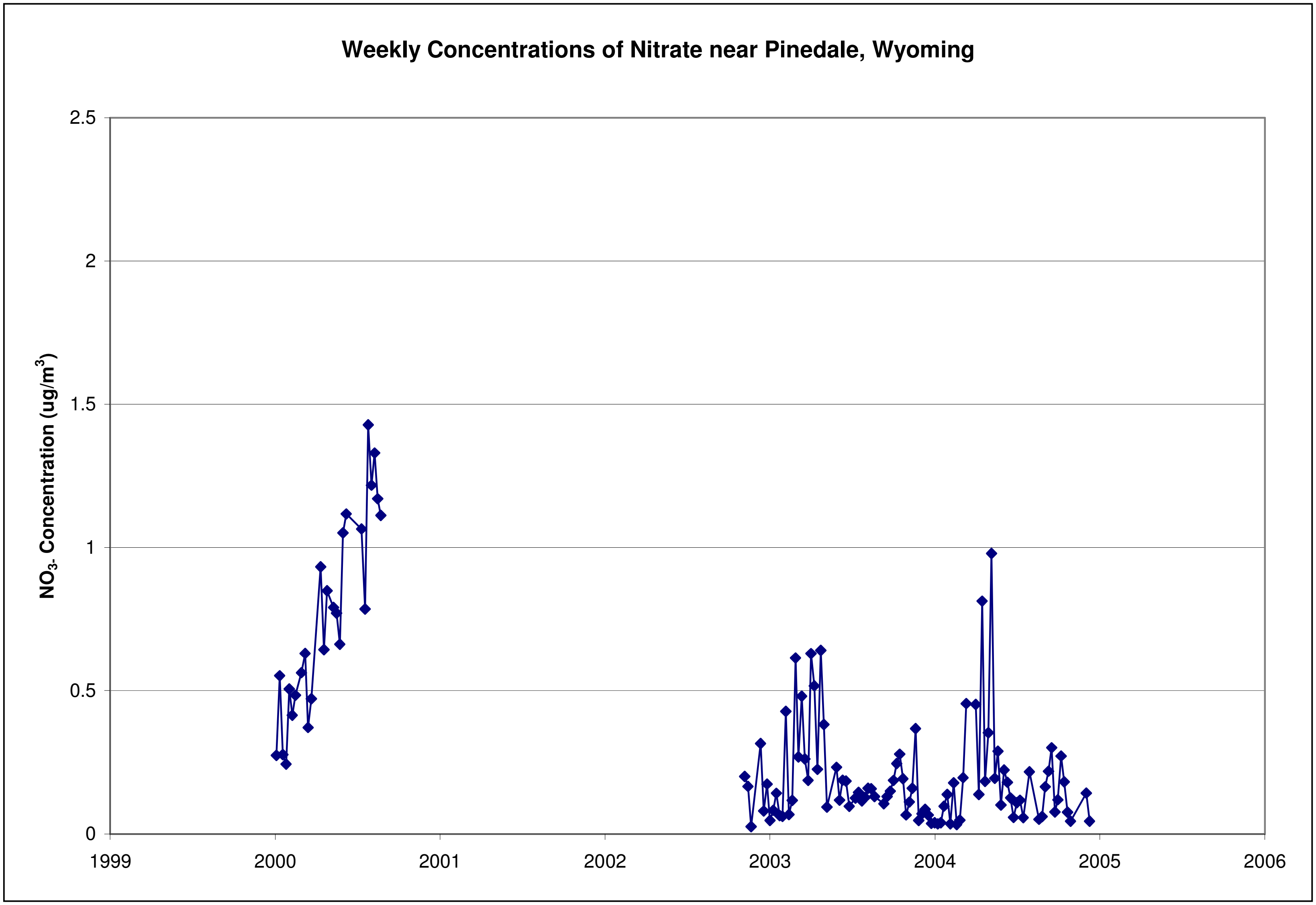
Source: BLM (Data from NADP[WY06] and CASTNET[PND165])

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



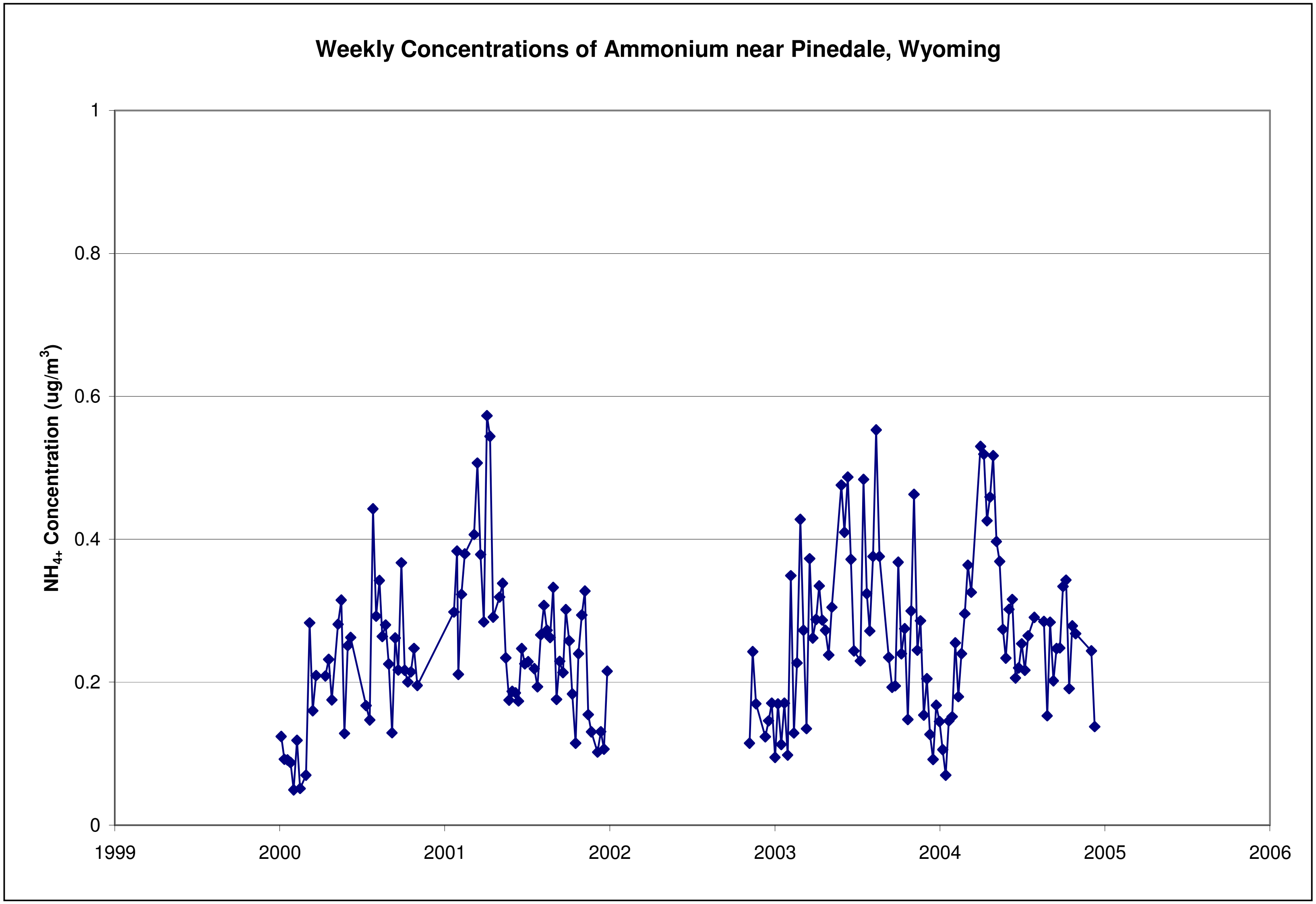
Source: BLM (Data from NADP[WY06] and CASTNET[PND165])

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



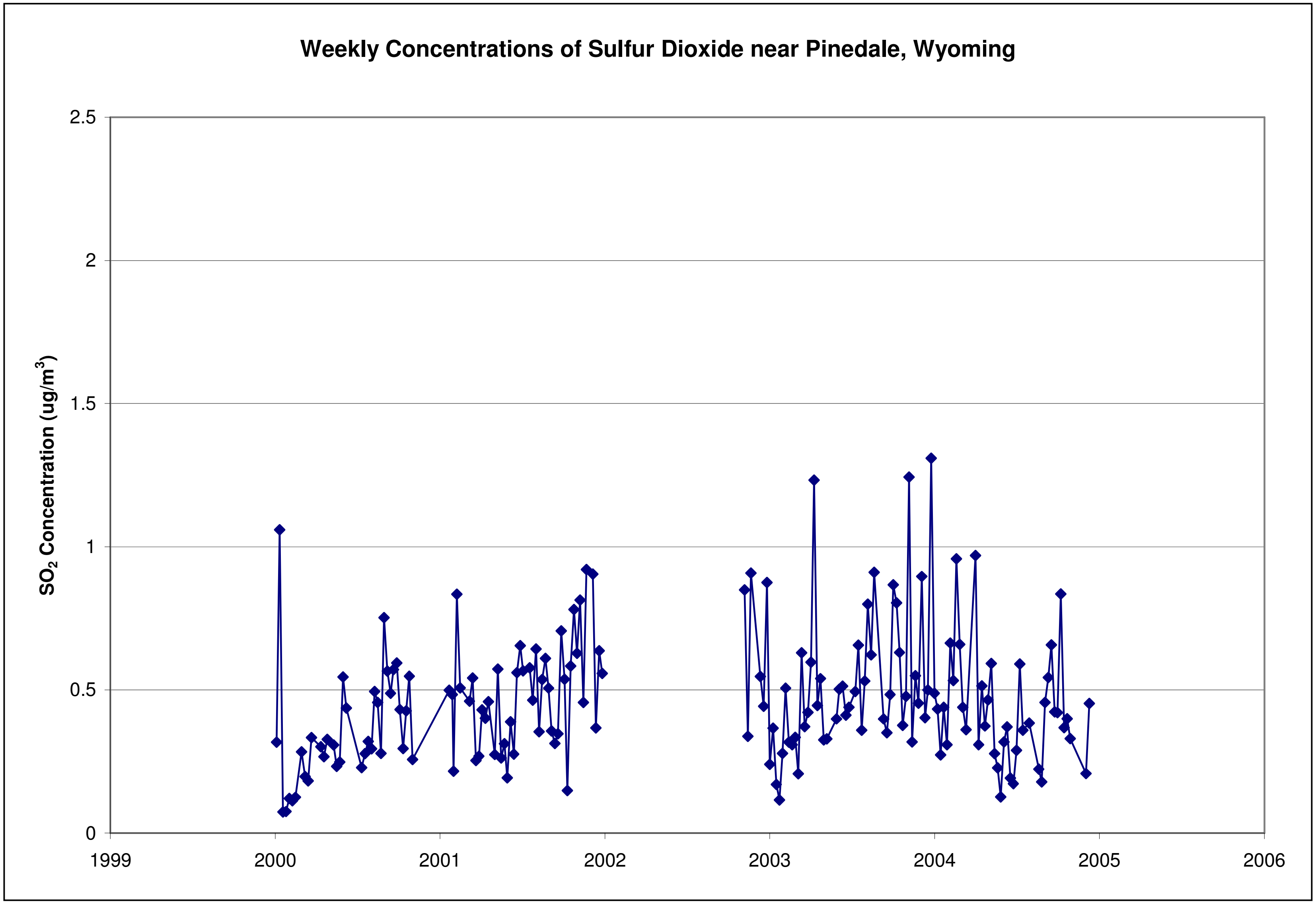
Source: BLM (Data from WARMS, Pinedale)

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



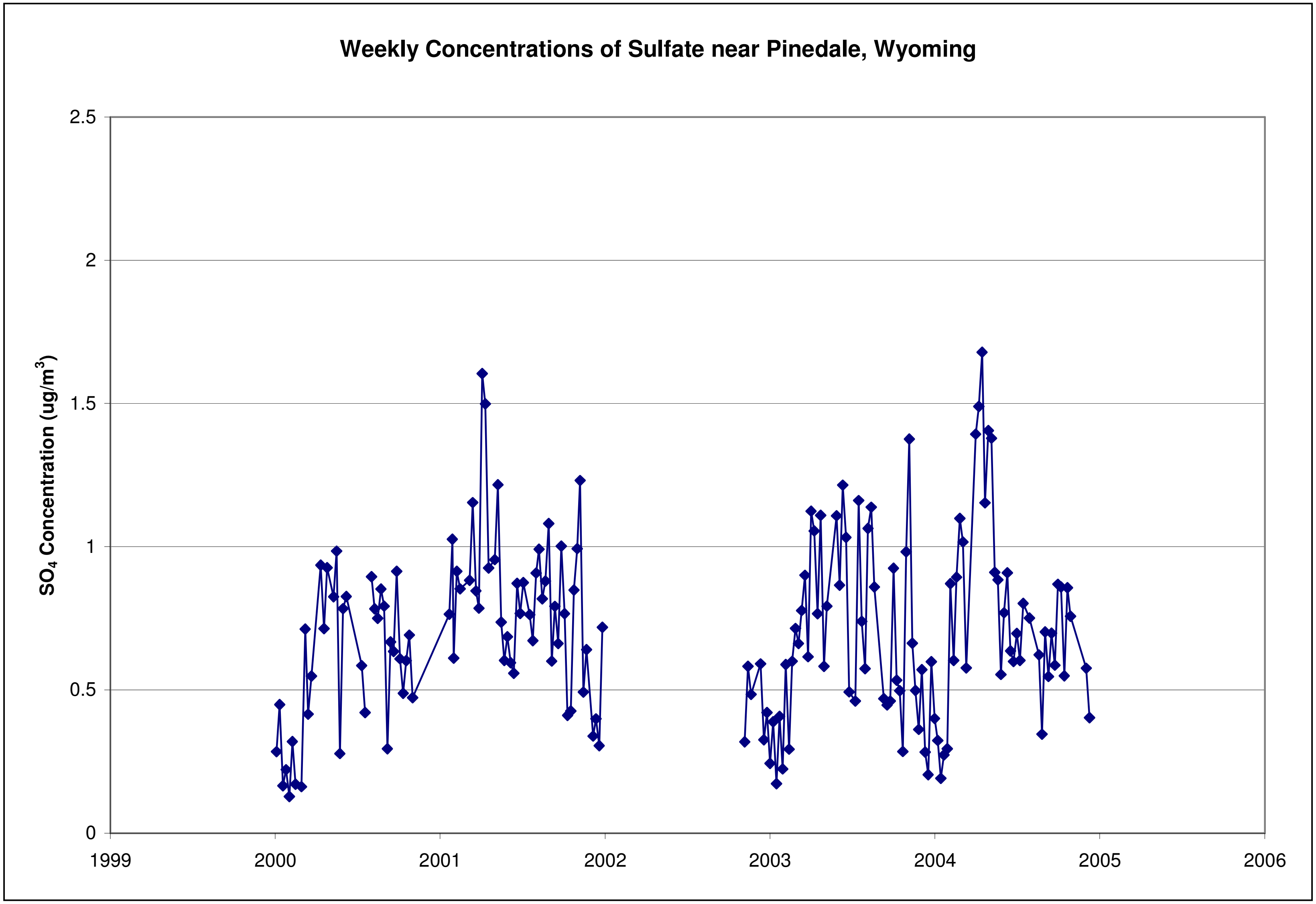
Source: BLM (Data from WARMS, Pinedale)

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.

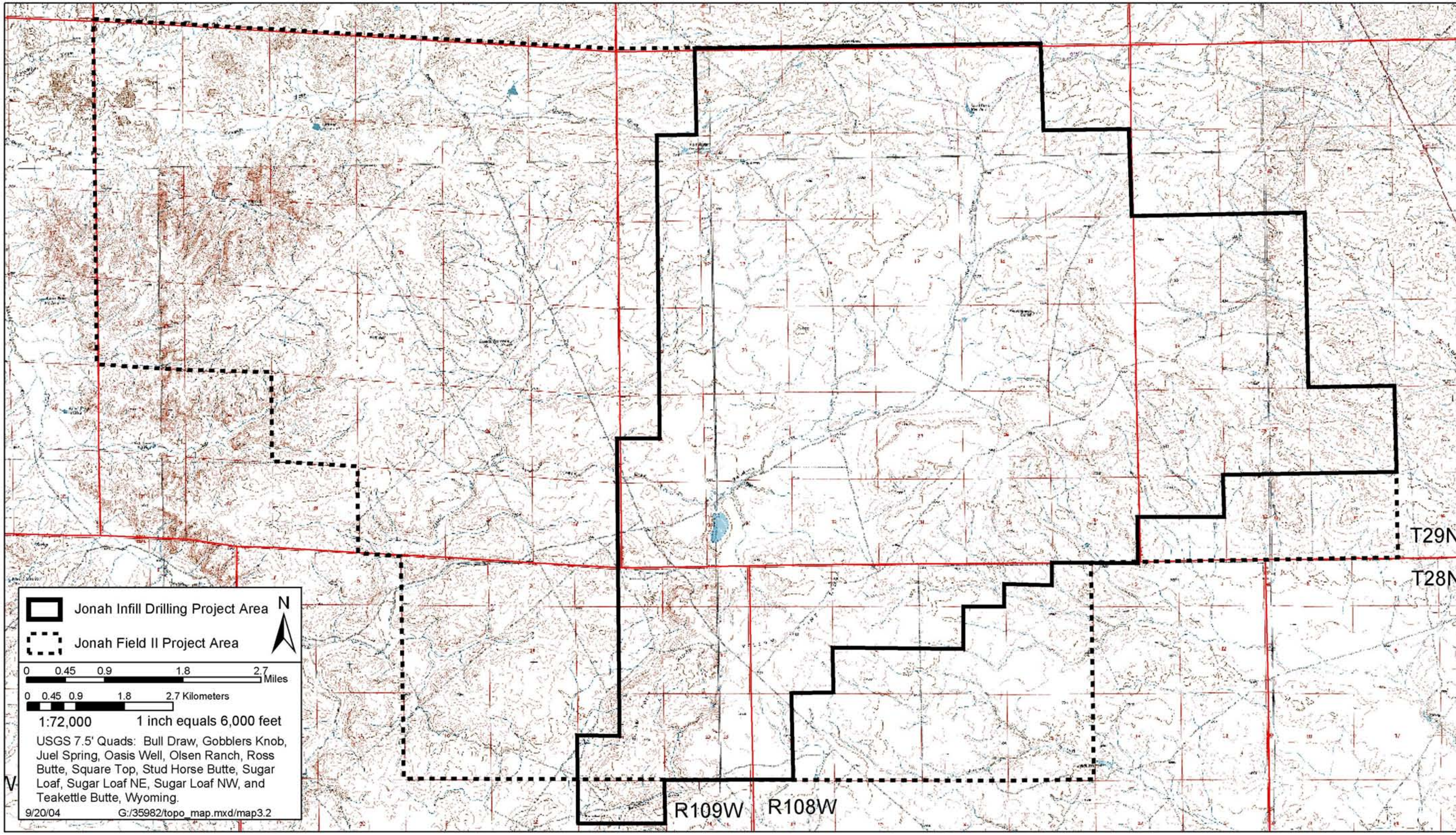
The JIDPA is underlain, in descending order, by the Tertiary Green River, Wasatch, and Fort Union Formations and an unnamed Tertiary bed; the Upper Cretaceous Lance Formation, Mesaverde Group (i.e., Almond Formation, Ericson Sandstone, Rock Springs Formation, and Blair Formation), and the Frontier Formation; 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

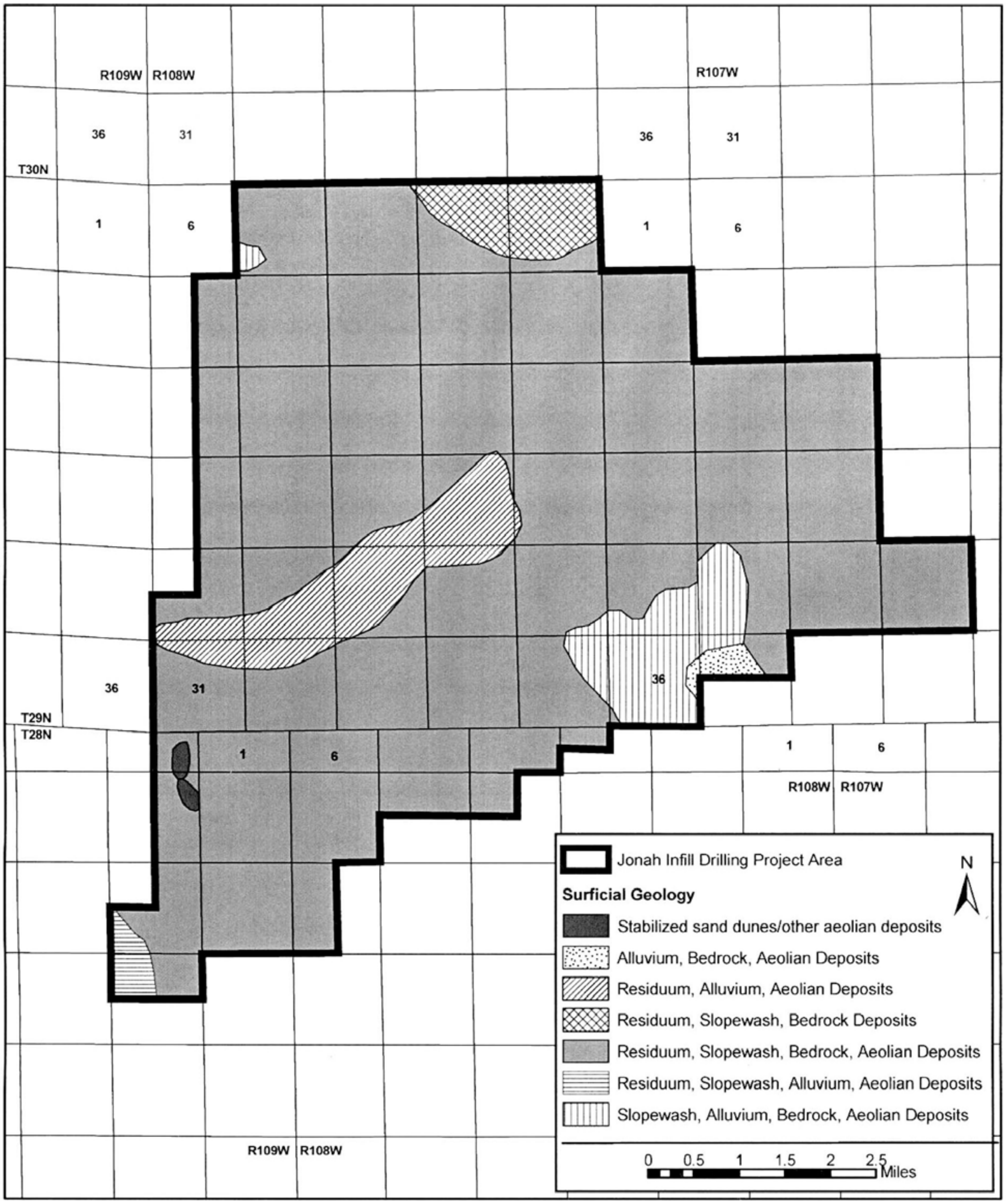
The mineral resources CIAA covers approximately 66,400 acres (103.8 square miles) on and surrounding the JIDPA and is defined as the combined Jonah EA, Jonah Field II EIS, and JIDPA areas (Map 3.5). Mineral resources within this area are generally as described below for the JIDPA; however, recovery of 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.



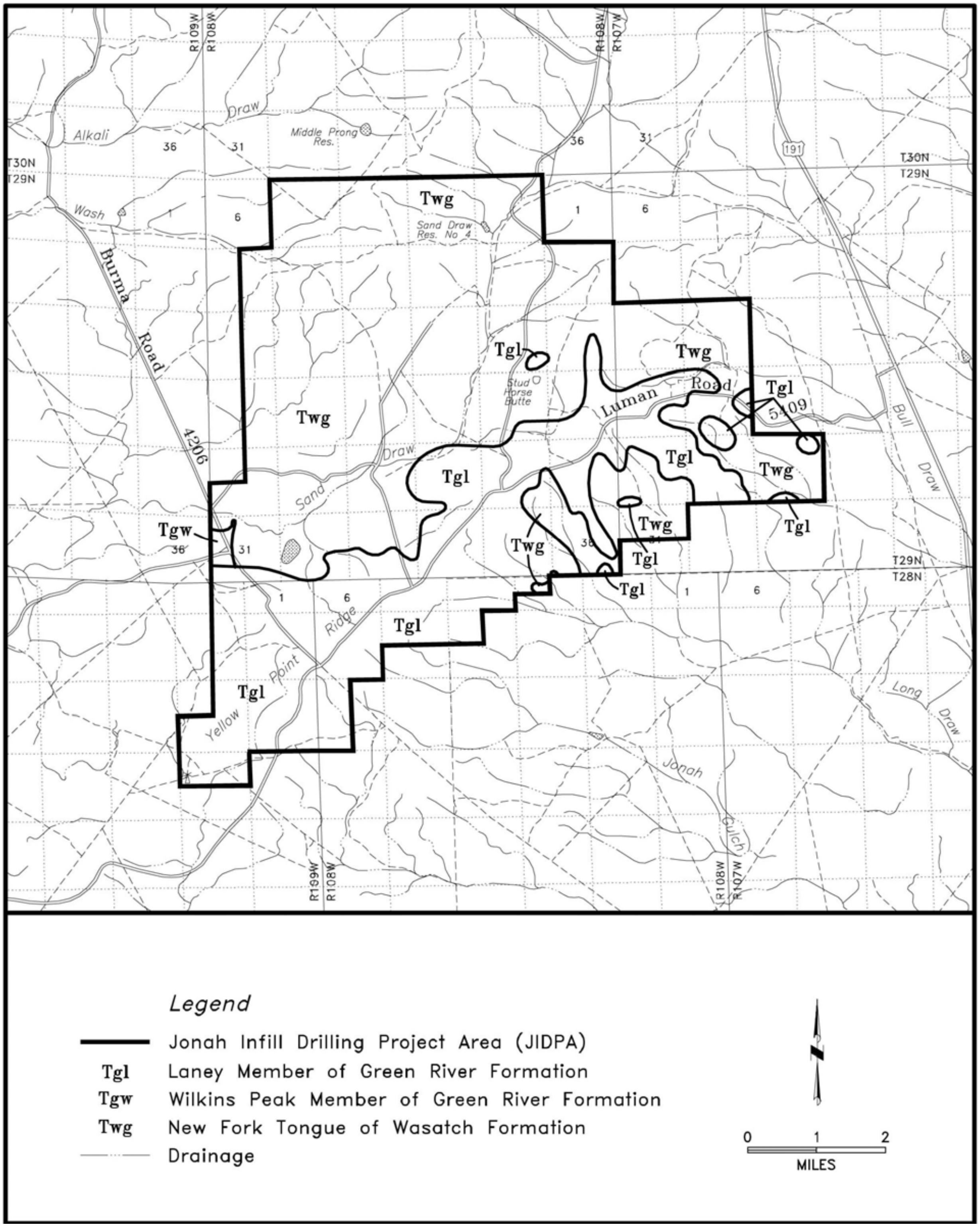
Source: BLM

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



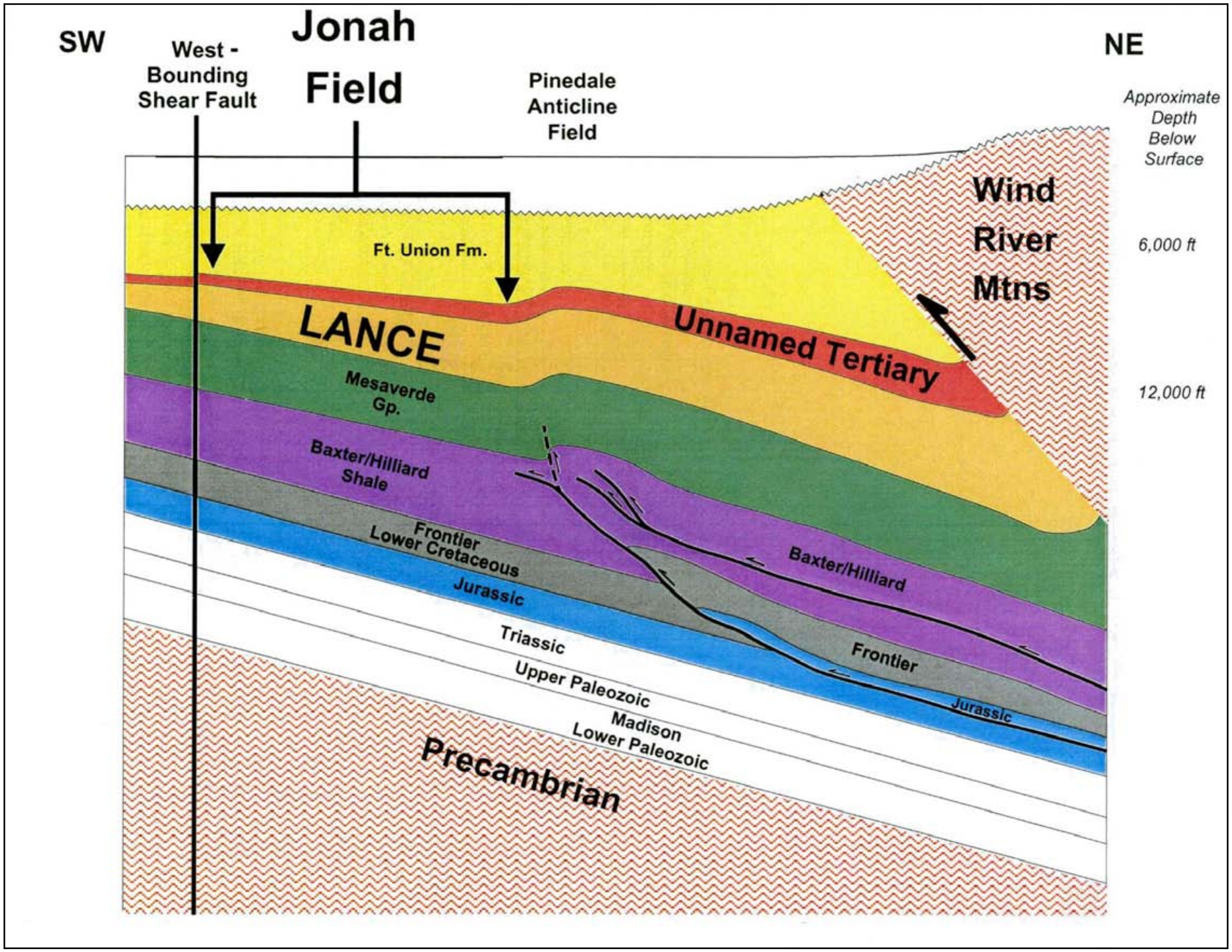
Source: BLM (Based on data from the Wyoming Geographic Information Science Center, 2003)

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



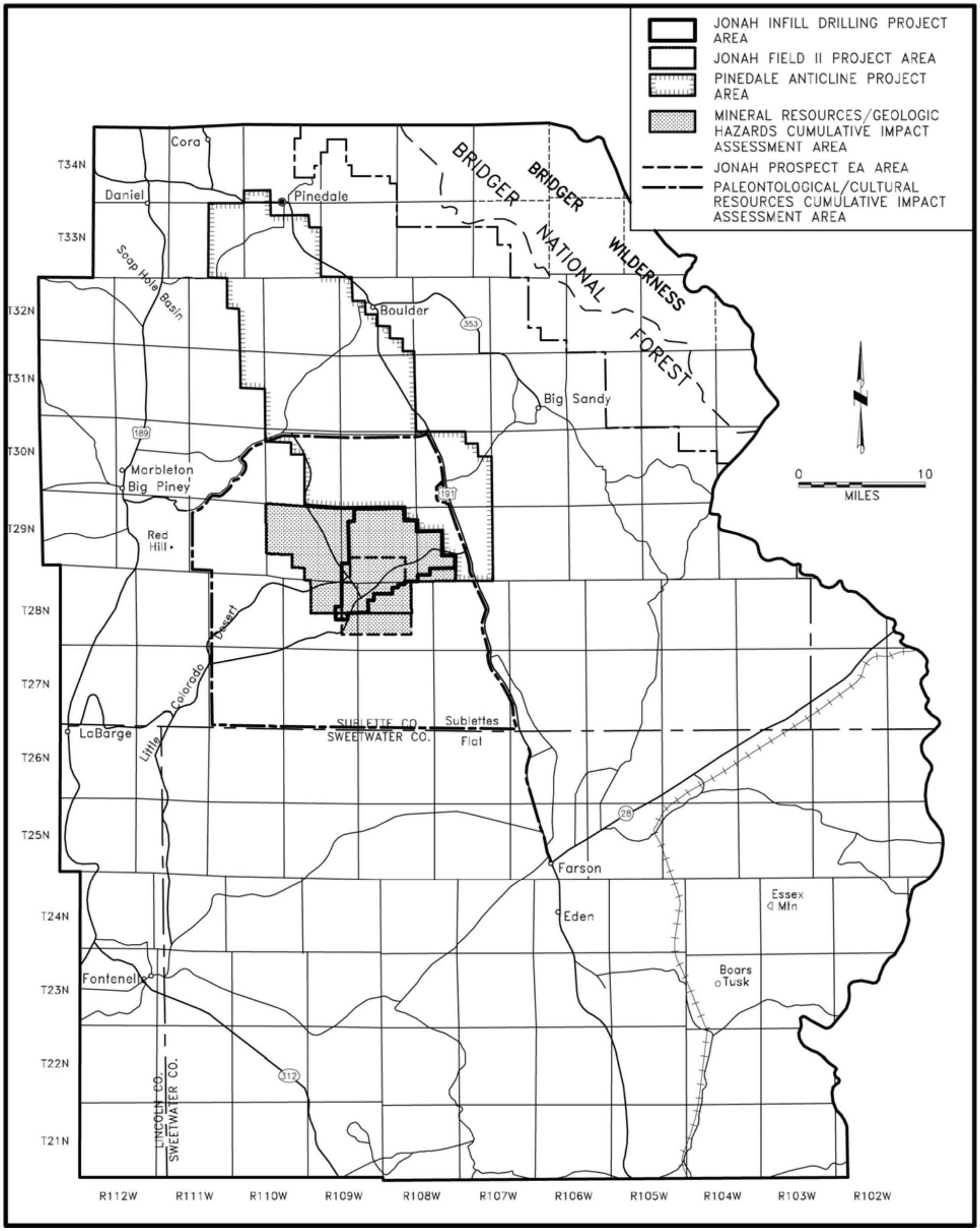
Source: BLM (Based on data from the Wyoming Geographic Information Science Center, 2003)

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

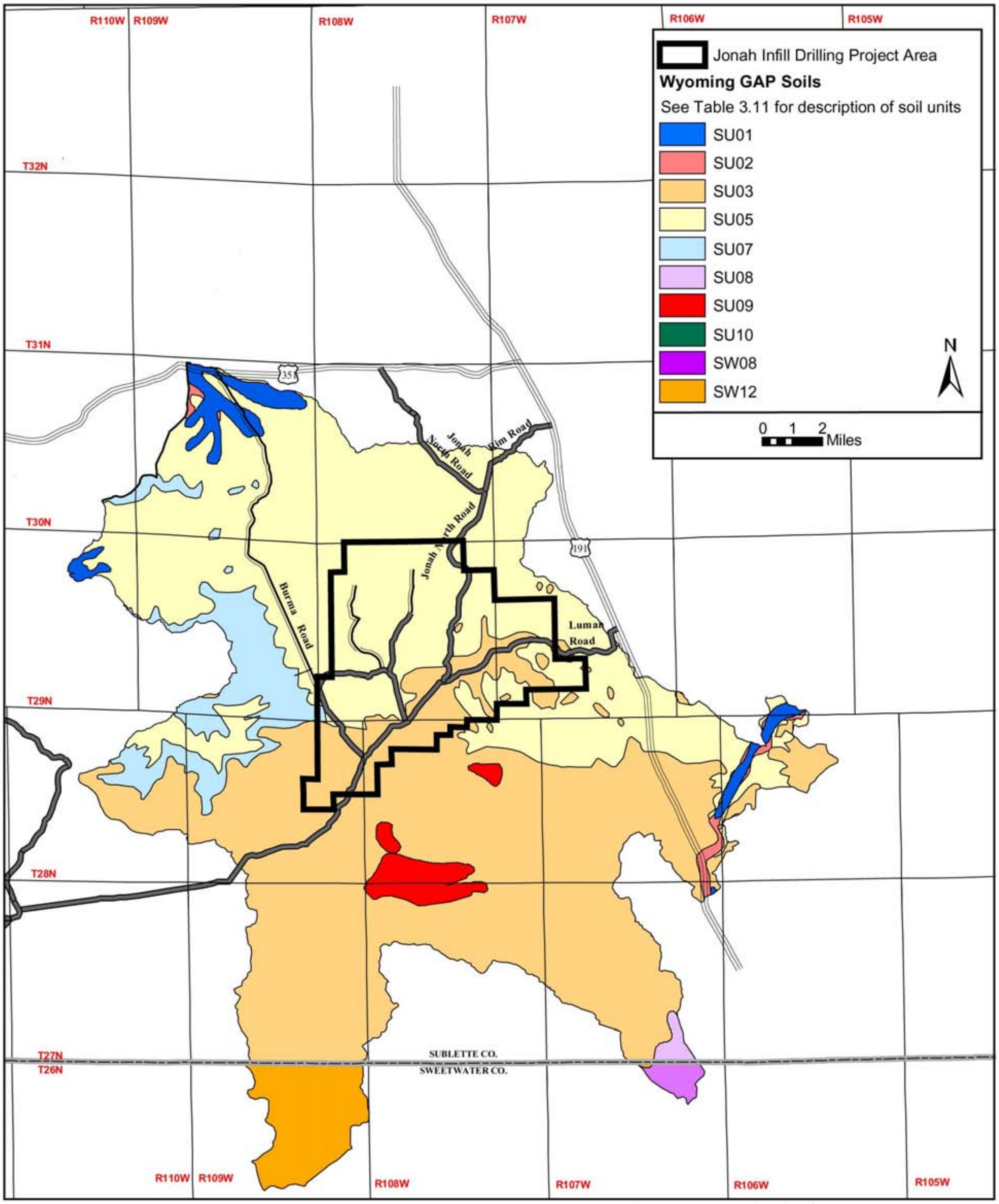
Huguston-Horsley-Terada complex on 6–30% slopes (map unit 116); and the Haterton-Garsid complex on 1–8% slopes (map unit 113) (see Table 3.12). These mapping units collectively cover approximately 78% of the JIDPA. The Cowestglen sand loam on 0–2% slopes (map unit 951/106) and the Monte-Leckman complex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



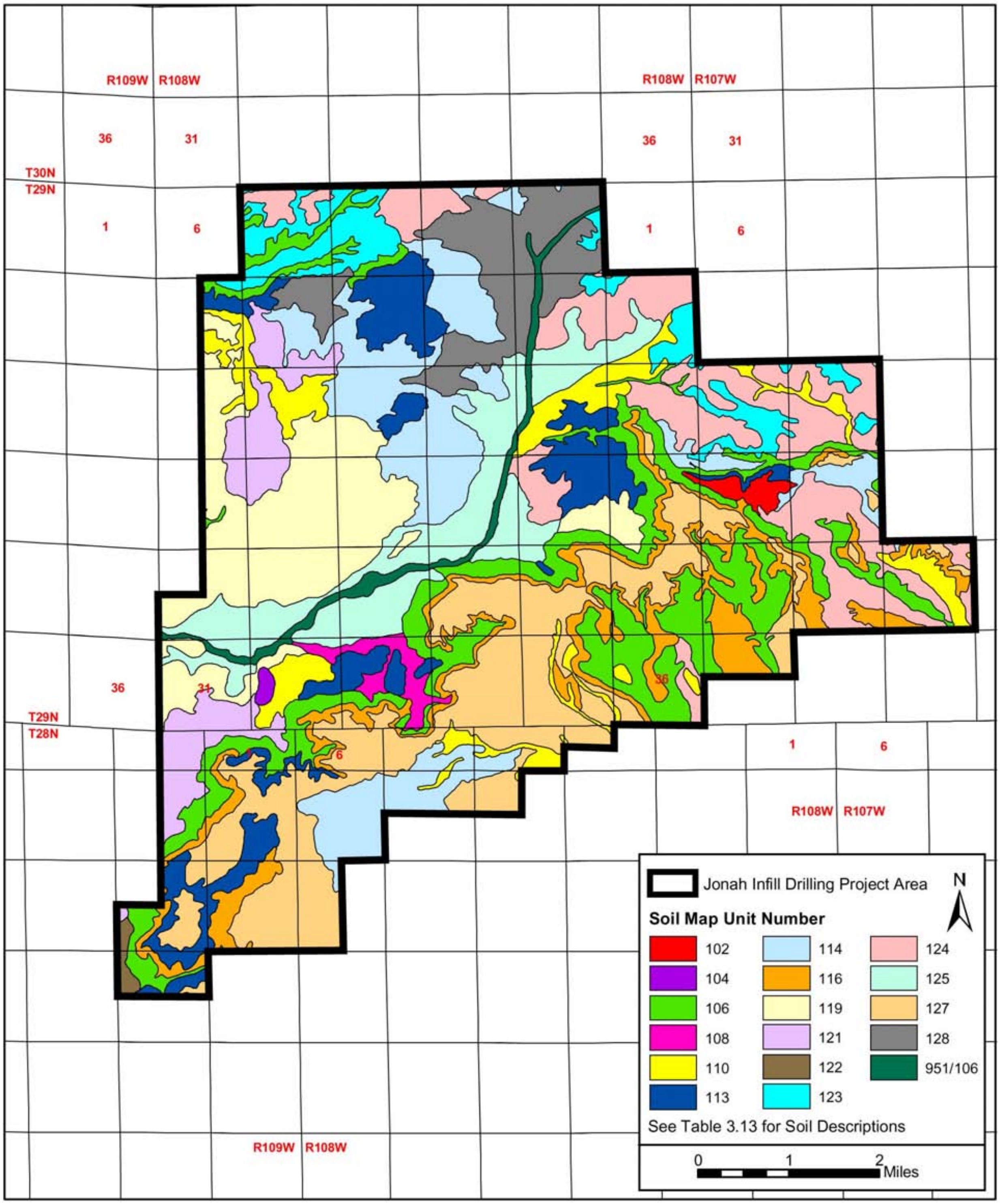
Source: BLM (Based on data from Munn & Arneson, 1999)

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

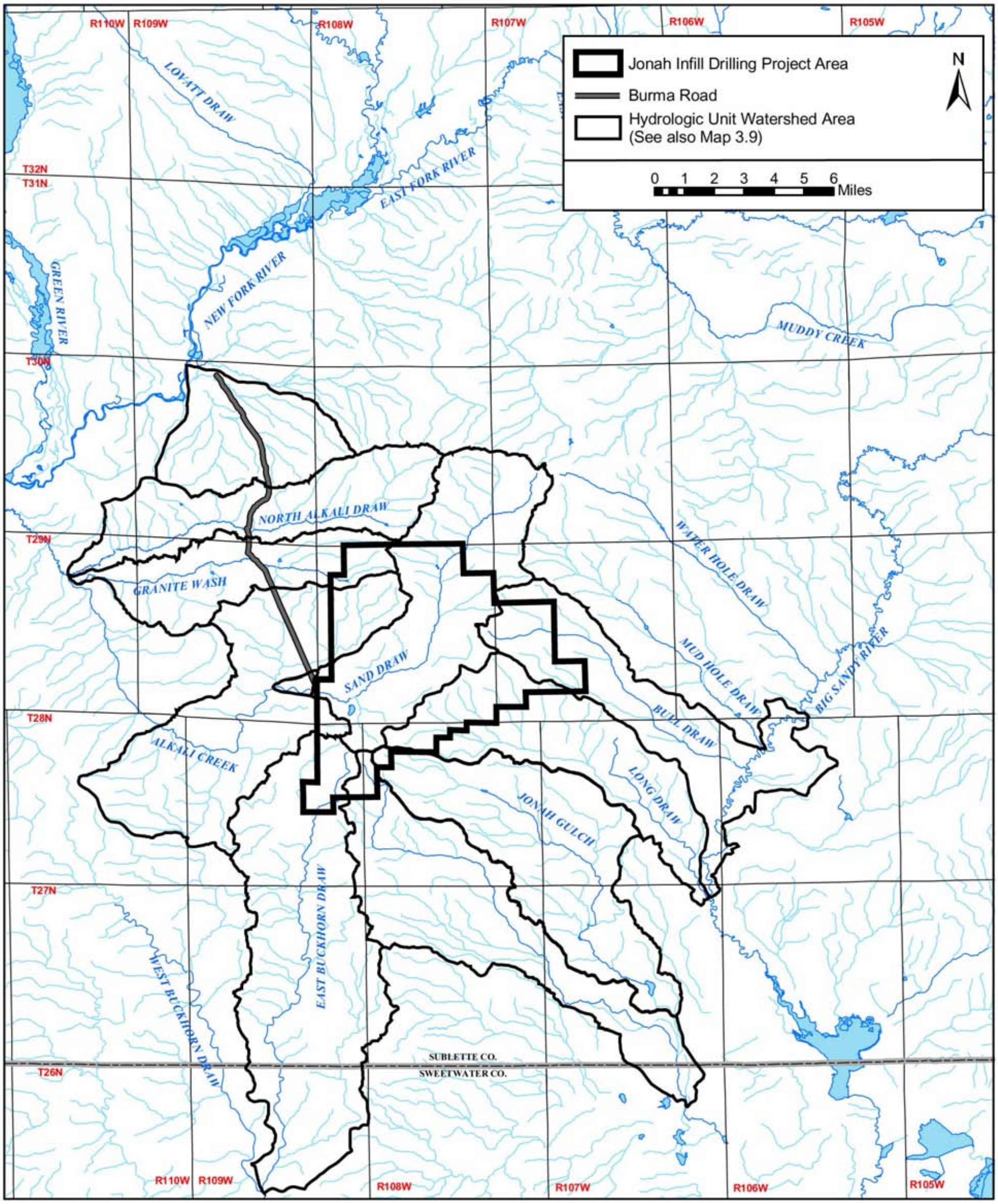
3.1.6.1 Surface Water

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).

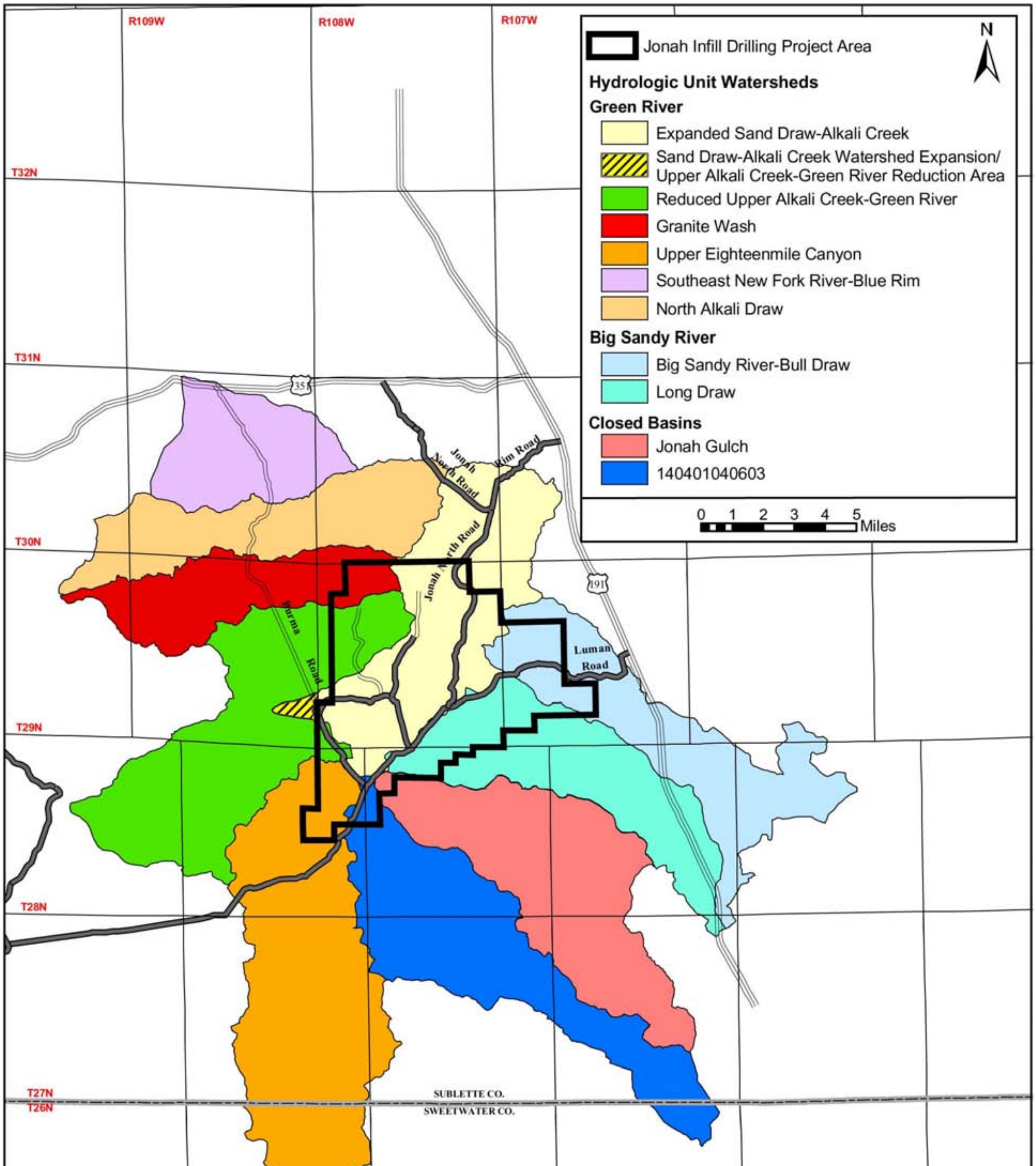
Table 3.14. Watershed Acreages, Jonah Infill Drilling Project, Sublette County, Wyoming, 2006

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

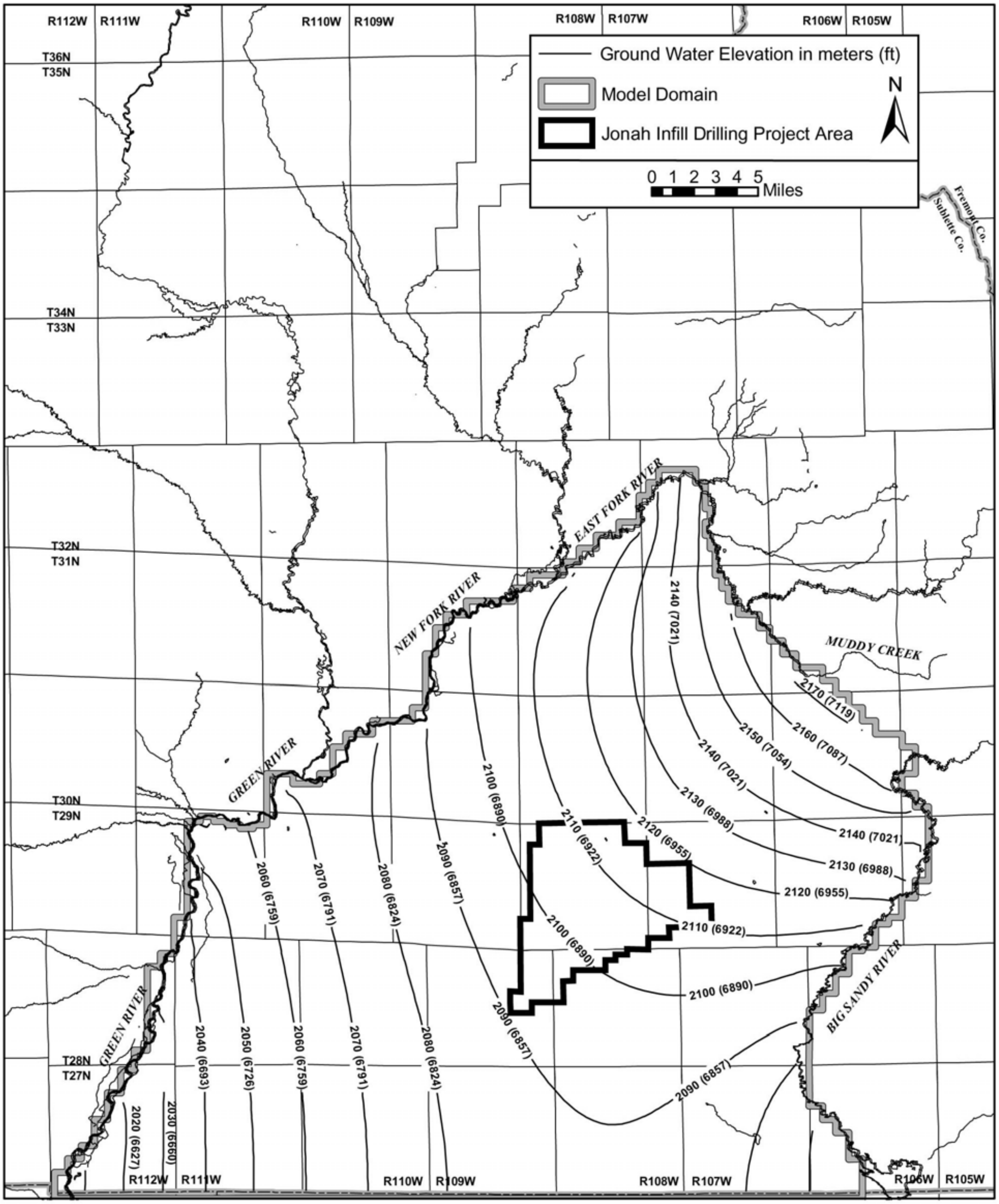
Five adjudicated and numerous unadjudicated surface water rights occur in the JIDPA (State Engineer's Office 2004). The major surface water uses in the JIDPA are for livestock and wildlife watering. Numerous impoundments and playas (internally drained, closed basins that periodically hold water) occur 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.

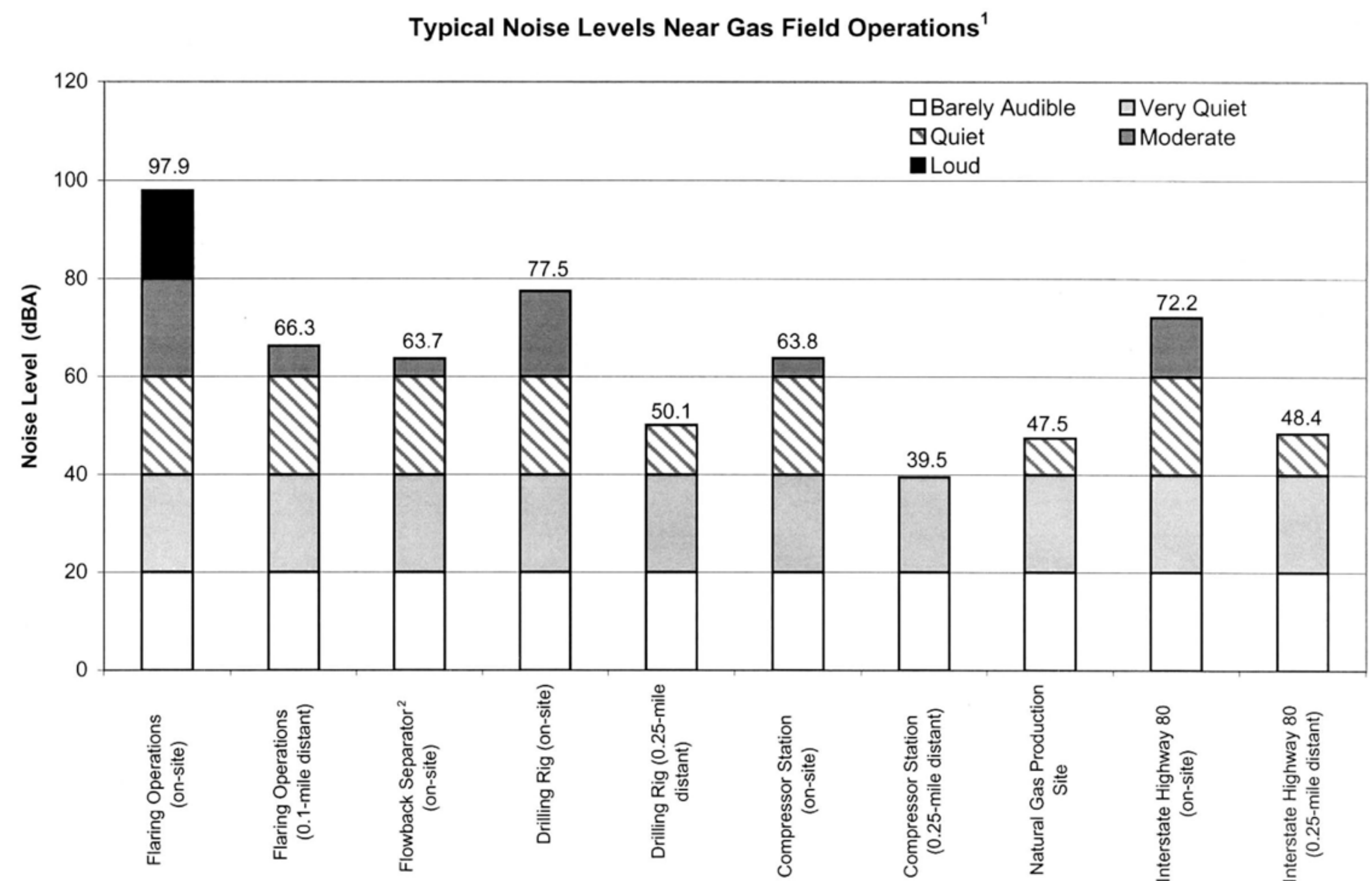
Noise-sensitive areas in the JIDPA include greater sage-grouse leks during the breeding season and occupied greater sage-grouse and raptor nests. No residences occur in or immediately adjacent to the area.

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.

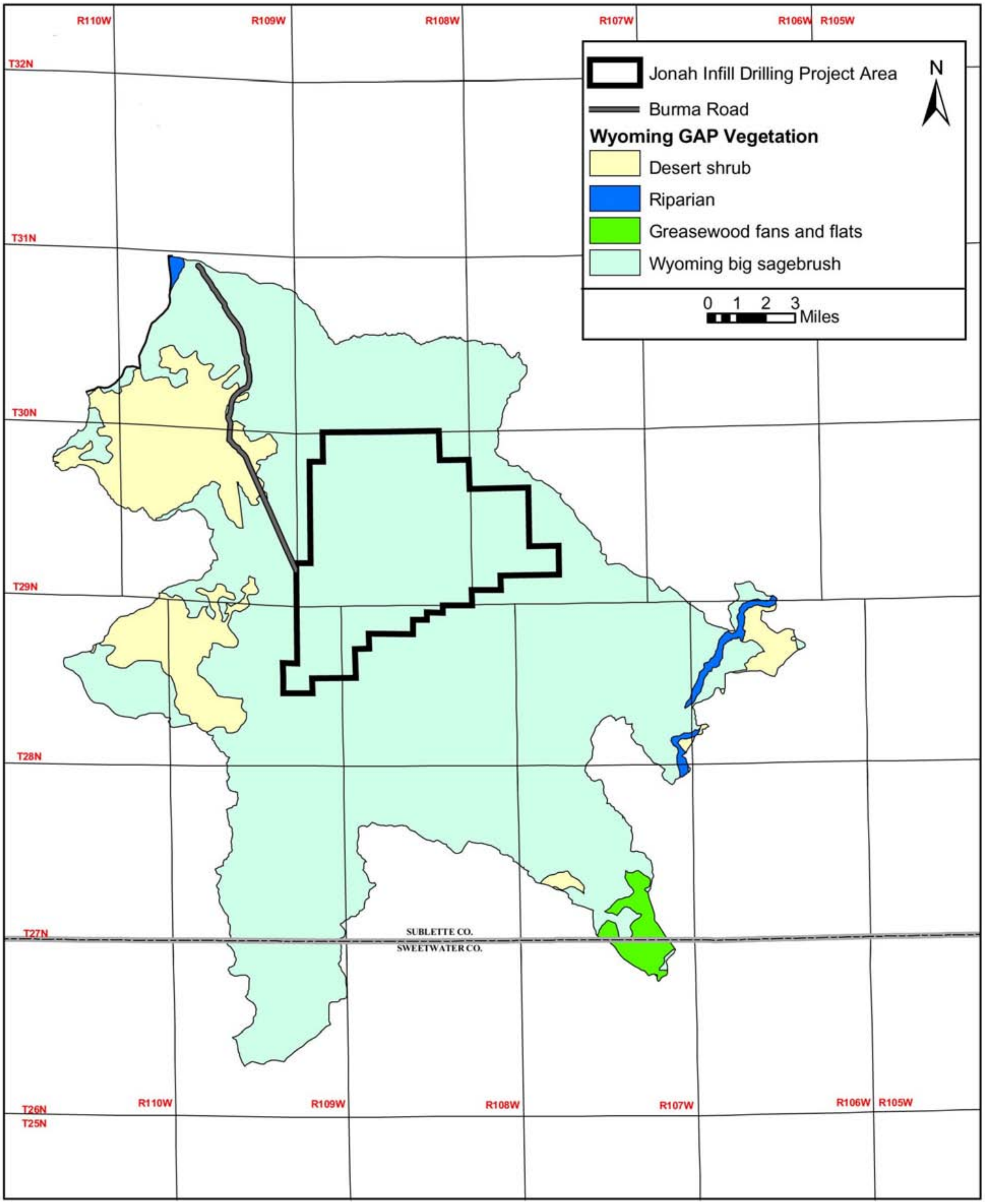
Vegetation in the JIDPA and CIAA (the same CIAA as for soils and other surface water; see Sections 3.1 and 3.16) is dominated by Wyoming big sagebrush grasslands. Included in this vegetation type are saltbush and cushionplant communities (BLM 1987b, Intermountain Ecosystems LC 1996, TRC Mariah 2001a, 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))

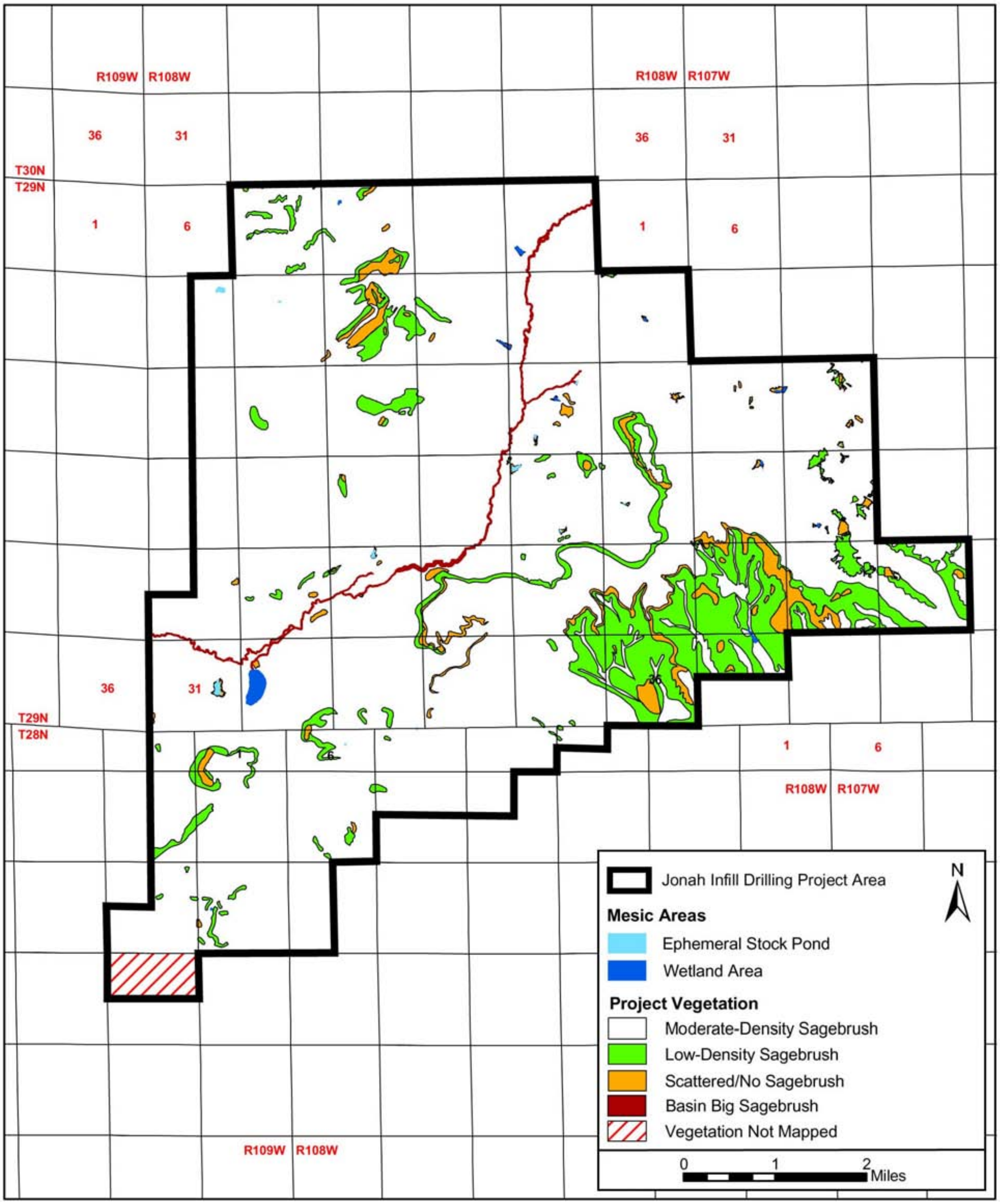
Map 3.11. Vegetation Communities (Course-Scale) in the Jonah Infill Drilling Project Area and Cumulative Impact Assessment Area, Sublette and Sweetwater Counties, Wyoming, 2006.

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.

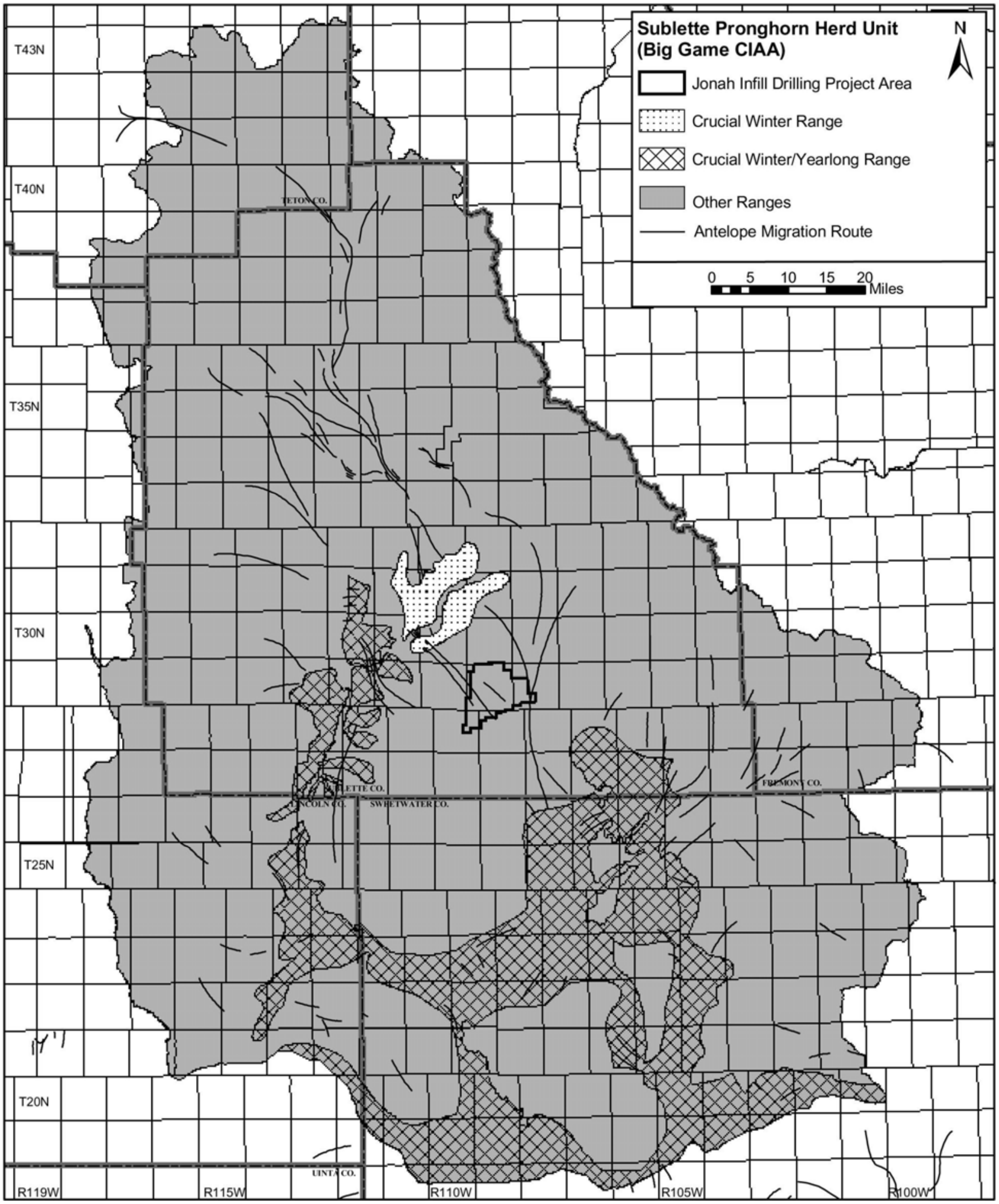
The WGFD population objective for the Sublette Herd Unit is 48,000 pronghorn antelope. The 2002 population was estimated at 44,700 (93% of the current objective), and the estimated population averaged 44,080 from 1997 to 2001 (WGFD 2002). Because of its large size, the Sublette Herd Unit has been divided 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

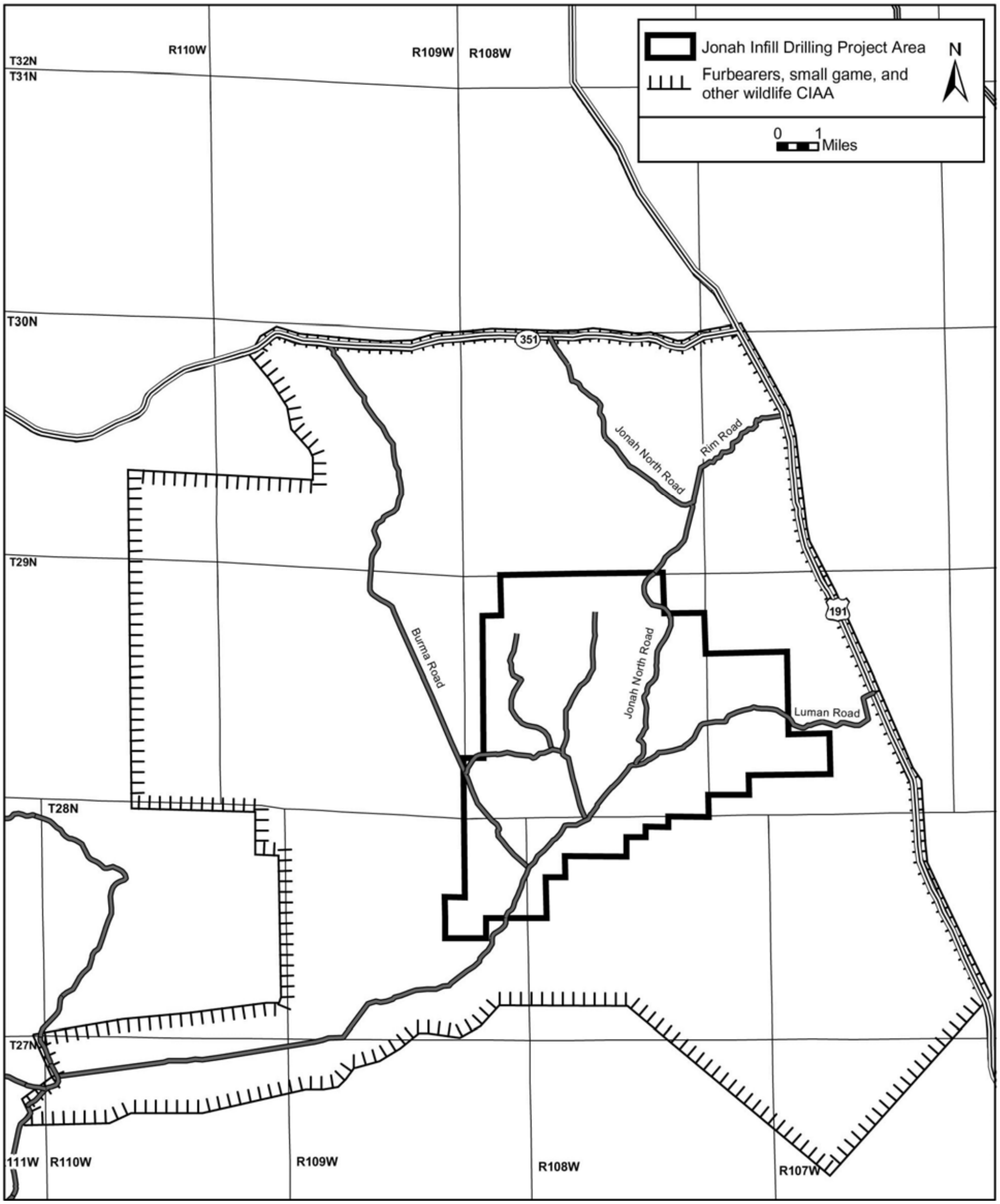
The CIAA for other wildlife encompasses approximately 188,888 acres (295 square miles) (Map 3.14). Existing disturbance within the CIAA includes approximately 2,729 acres (4.3 square miles), or 1.4% of the CIAA, and results primarily from road and pipeline ROWs (44%) and existing long-term disturbance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

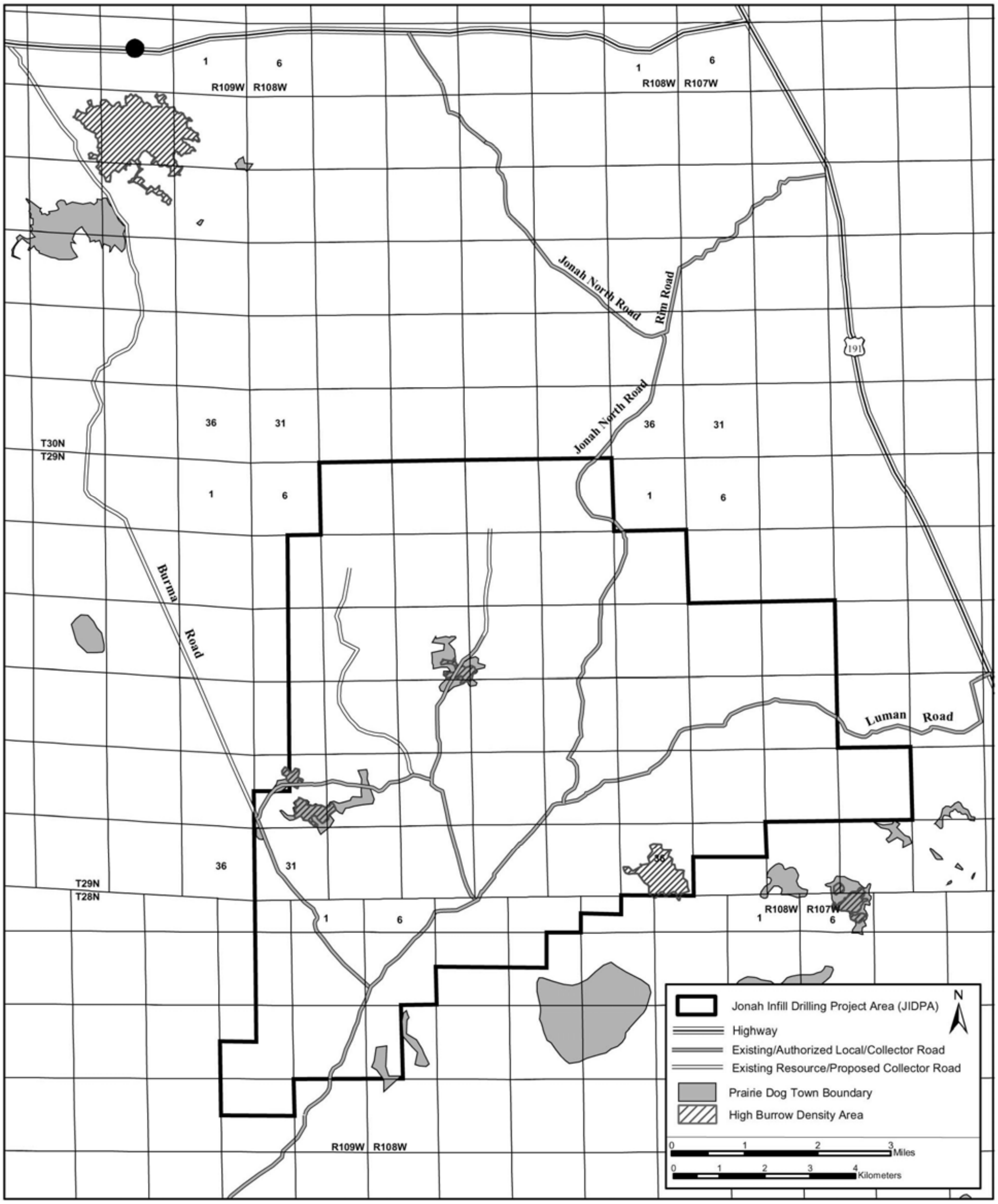
Based on geographic range and habitat preferences, a variety of raptor species may occur within the JIDPA (Dorn and Dorn 1999, WGFD 1999). Raptor nest surveys are conducted annually on the JIDPA and within the greater Jonah Wildlife Study Area (TRC Mariah 2004a). All known raptor nests/nest sites are 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

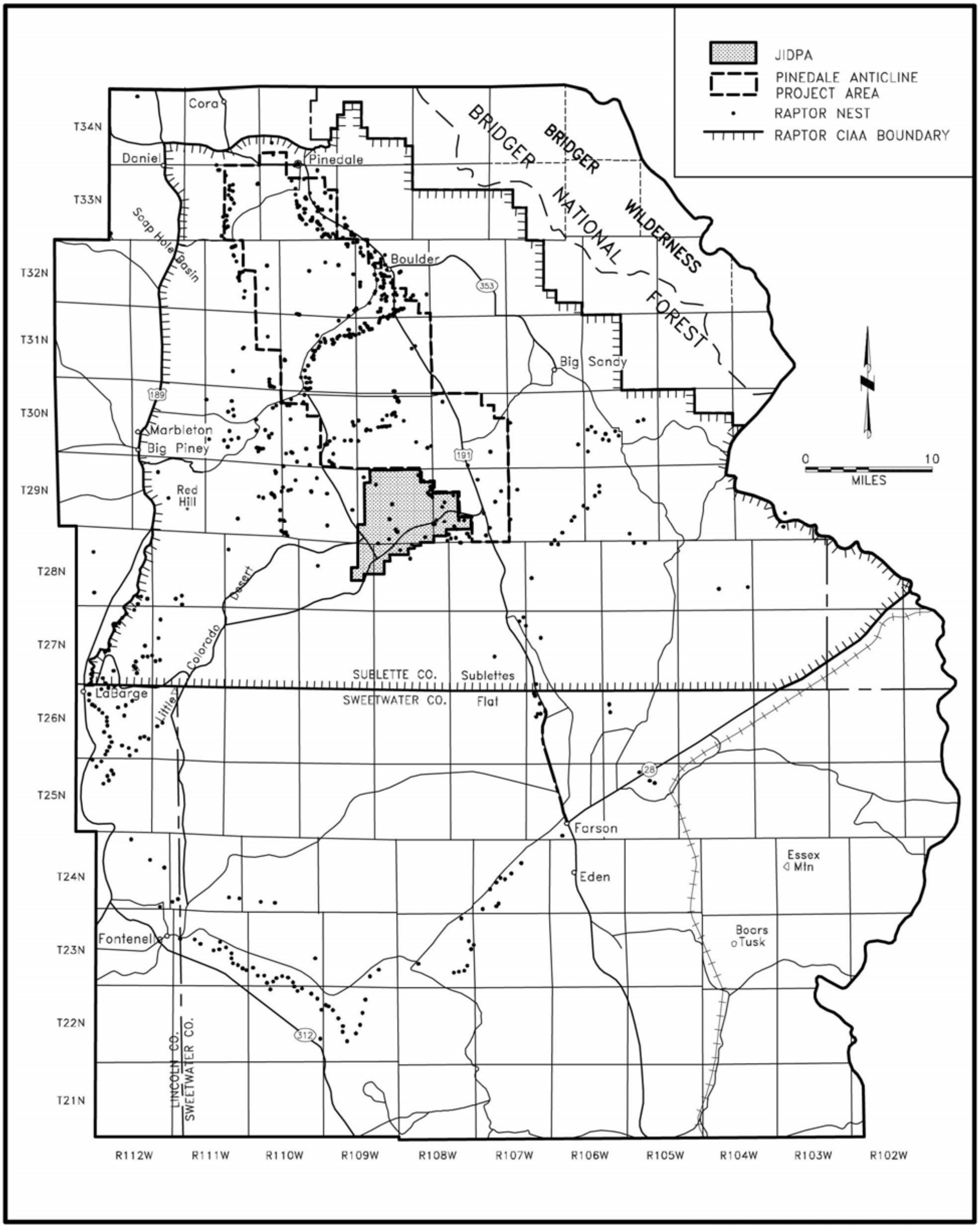
The principal upland game bird inhabiting the JIDPA is greater sage-grouse. A detailed summary of known greater sage-grouse lek activity on the JIDPA is provided in *2003 Wildlife Studies, Jonah Field II Natural Gas Development Project* (TRC Mariah 2004a). The CIAA for greater sage-grouse encompasses 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



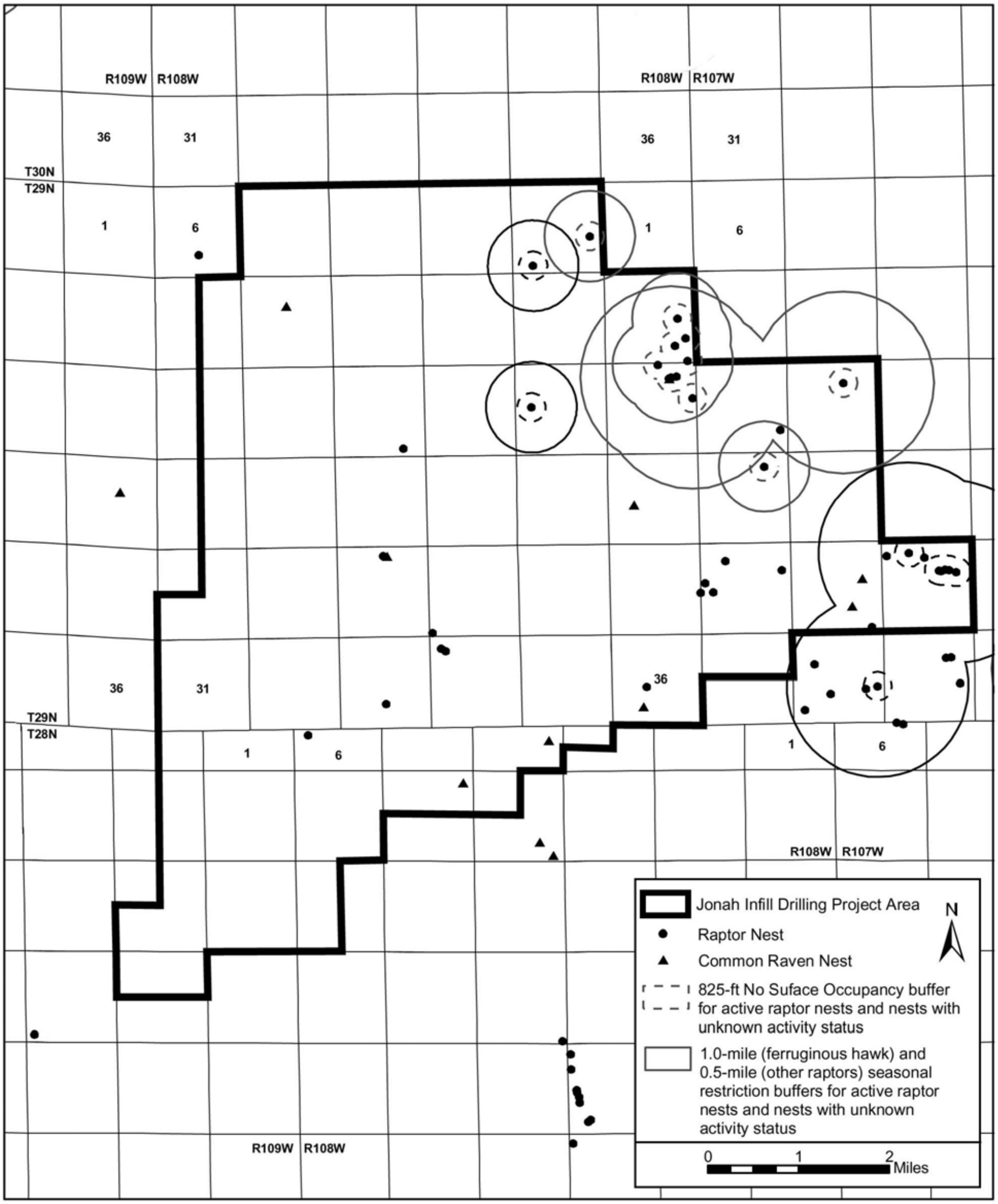
Source: BLM (Based on data from TRC Mariah, 2004)

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



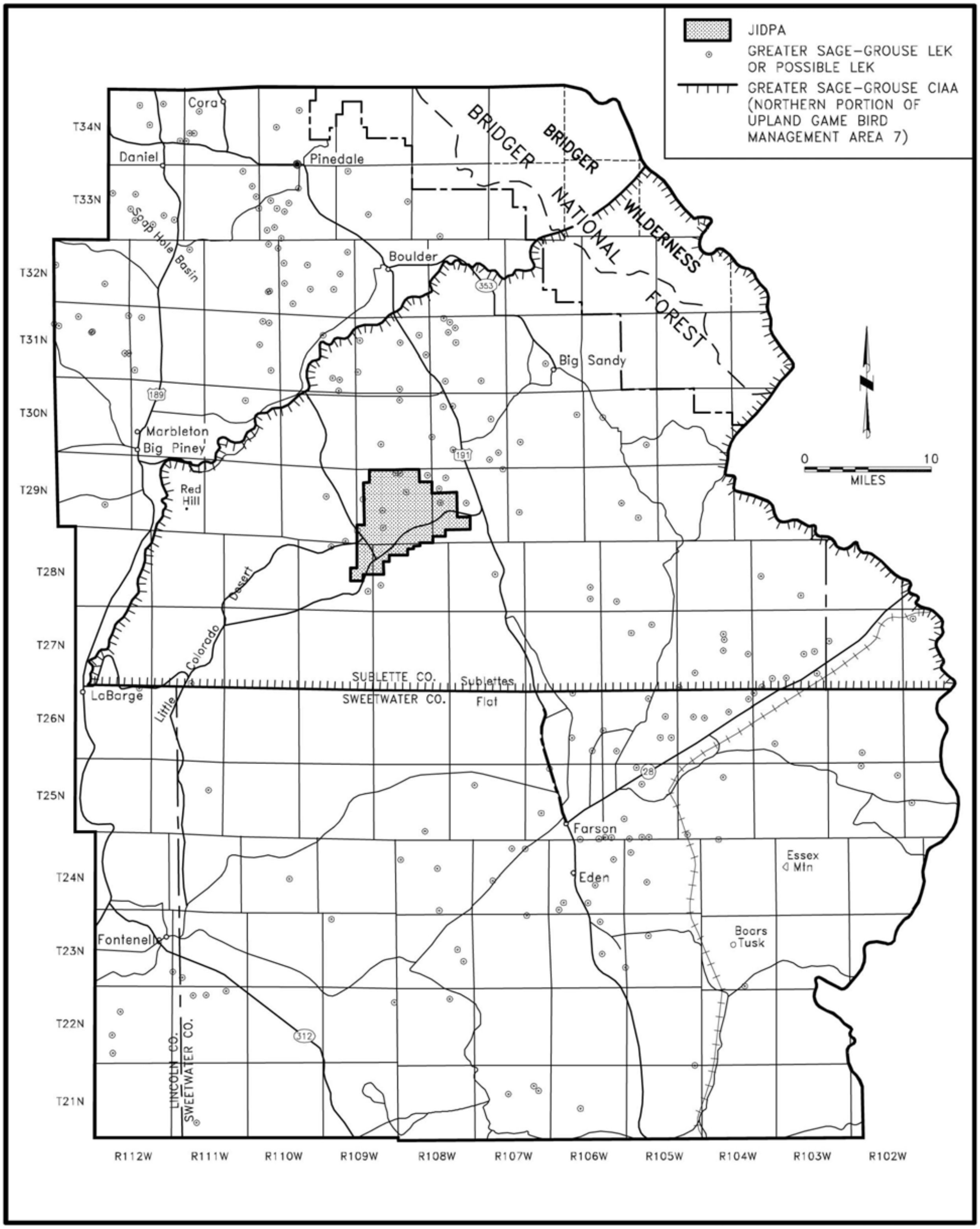
Source: BLM

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.

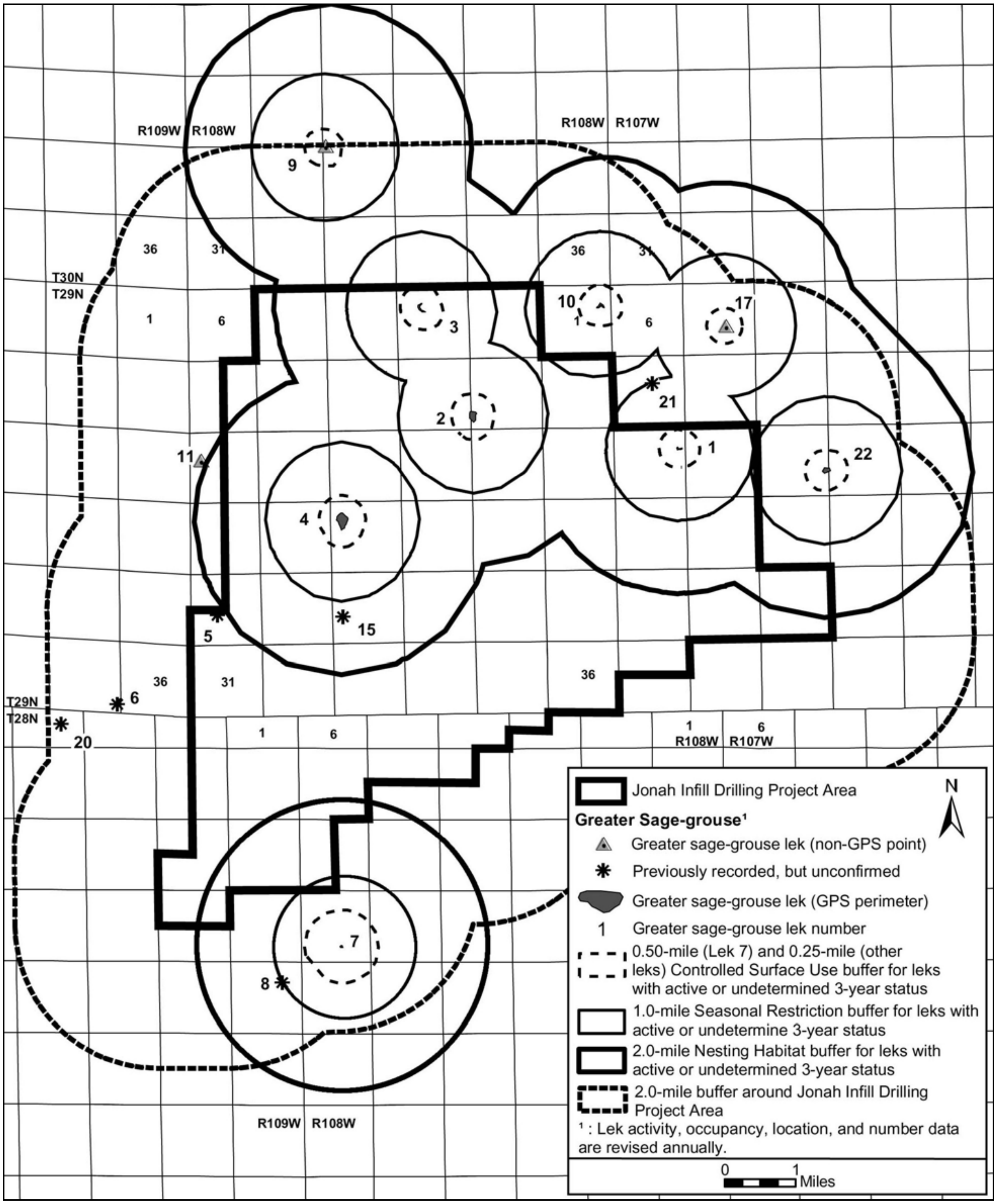
(Braun et al. 1976, Braun 1995, Connelly et al. 2004). Eleven of 13 states have shown significant declines. Historically, Wyoming supported more greater sage-grouse than any other state due to the presence of extensive sagebrush habitats (Patterson 1952). The areas in central and western Wyoming, where 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

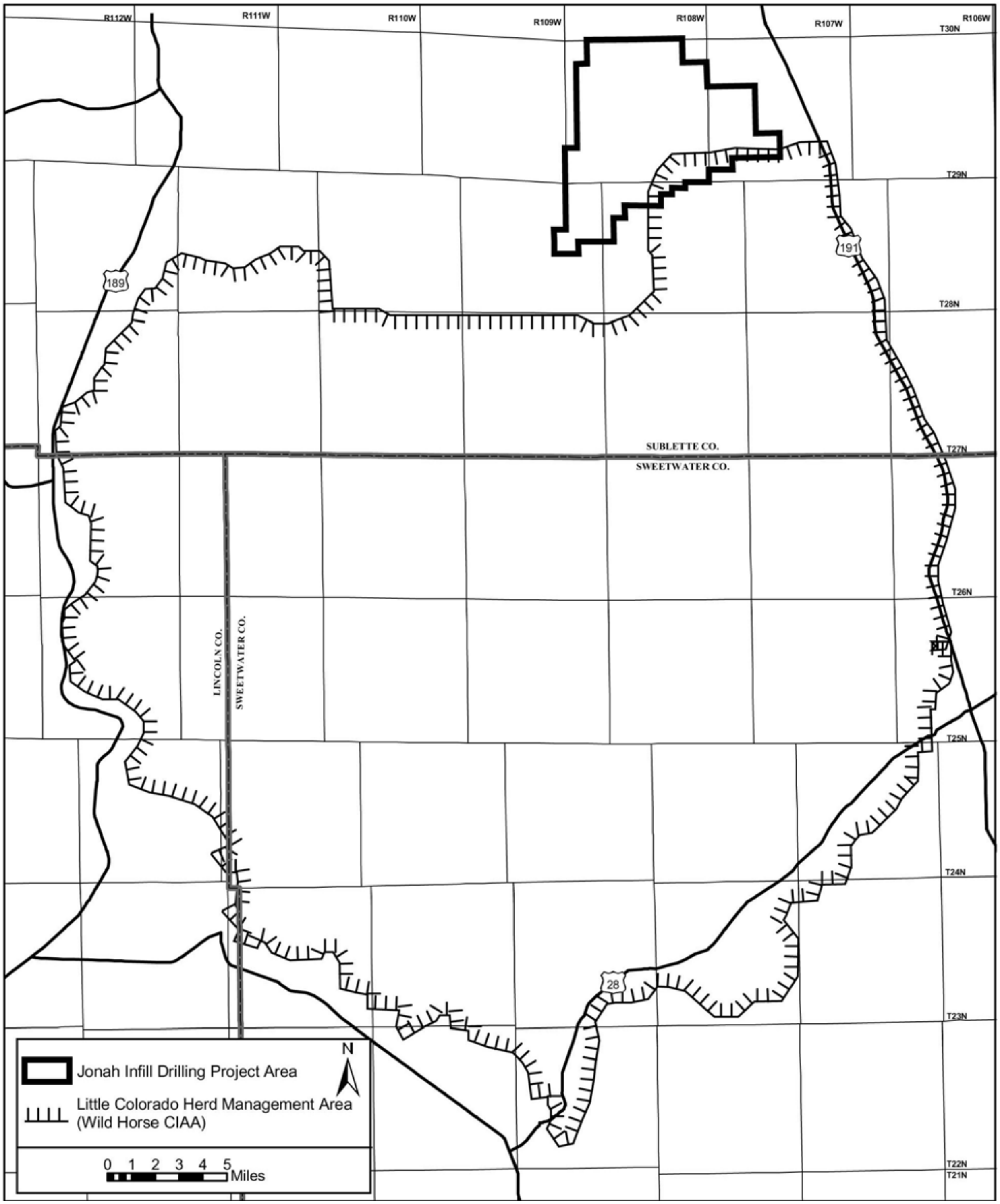
Spanish explorers originally introduced wild horses, also known as the American feral horses or mustangs, to the western United States. Over the years, wild horses have become a mix of numerous breeds that have escaped or been released by the U.S. cavalry, farmers, ranchers, and miners. That portion 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		2000			Change 1990–2000
	Total Housing Units	Second Home Units	Total Housing Units	Second Home Units	% Second Homes	
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%

1Taylor 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.

Rock Springs

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.

Eden/Farson

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)

Rank	County	All Items	Food	Housing	Apparel	Transportation	Medical	Recreation and Personal Care
		Second Quarter 2005						
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.

<u>Royalties</u>

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.

<u>Payments in Lieu of Taxes (PILT)</u>

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

Tax and Distribution Entity	Distributions (Thousands of $)[1]						
	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]

Species	Wyoming						Sublette Antelope Herd Unit[2]					
	Hunters per Year[3]			Hunter-Days per Year[3,4]			Hunters per Year[3]			Hunter-Days per Year[3,4]		
	Total	Resident	Non-resident	Total	Resident	Non-resident	Total	Resident	Non-resident	Total	Resident	Non-resident
Pronghorn	33,569	15,776	17,793	101,989	51,208	50,781	4,382	2,881	1,501	13,490	9,356	4,134

[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.

Furbearers, Small Game, Upland Birds, and Waterfowl

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

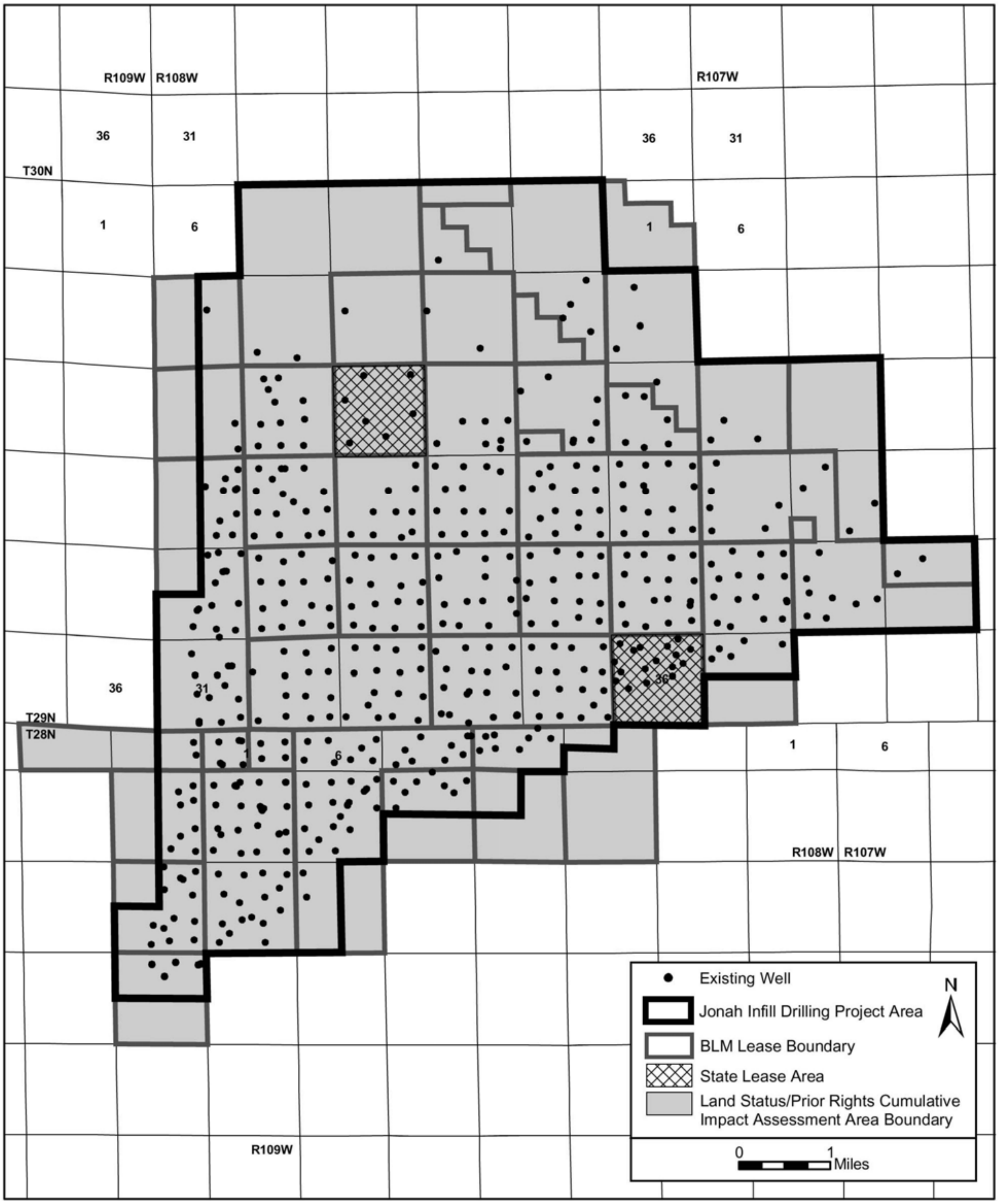
The JIDPA consists of federal surface/federal minerals administered by the BLM (94%/28,580 acres), two sections (1,280 acres) of State of Wyoming surface/mineral, and one section (640 acres) of private surface/federal minerals (see Map 1.1). Current land use includes energy production and development (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

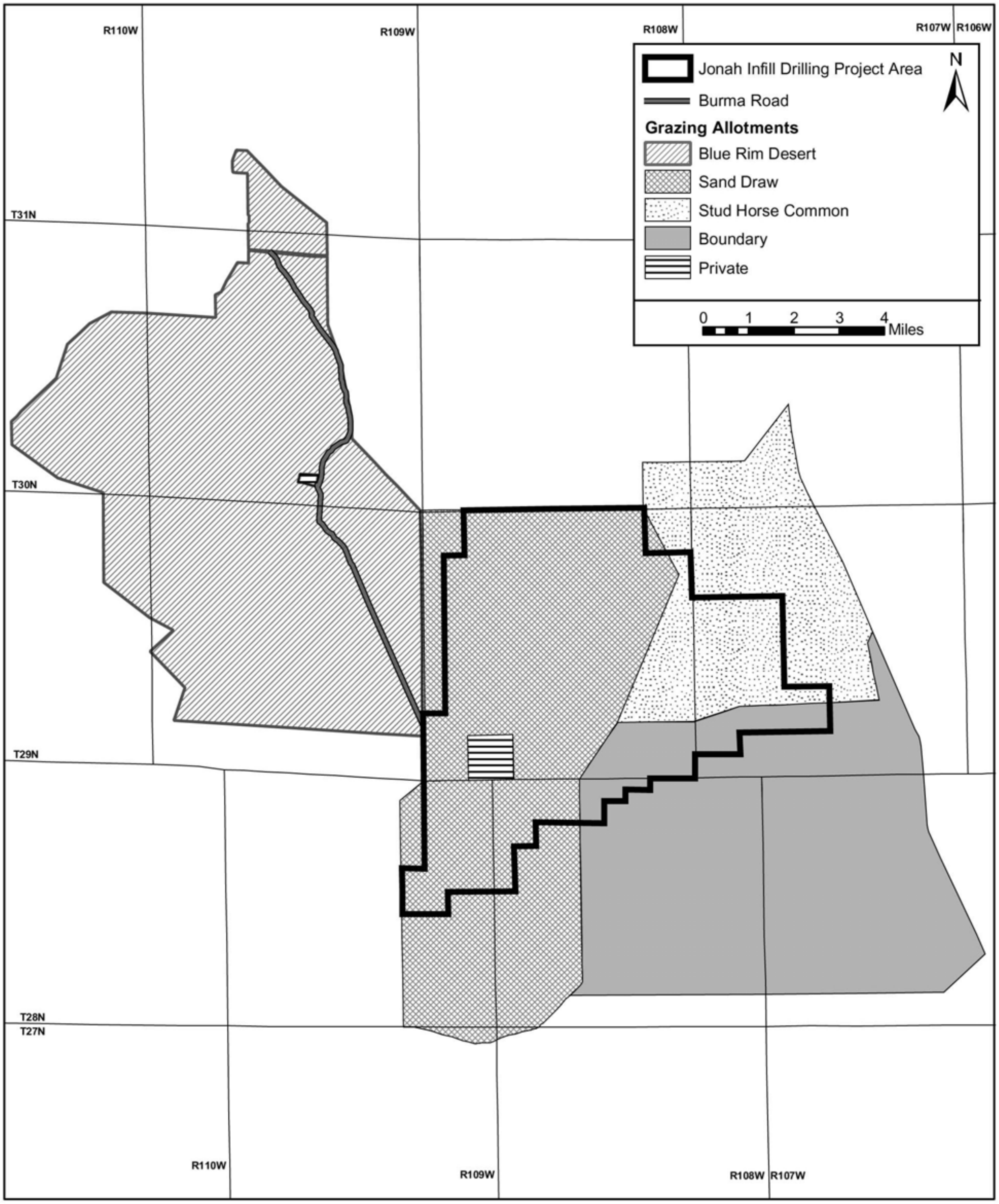
The JIDPA includes portions of three grazing allotments—Stud Horse Common, Sand Draw Common, and Boundary—and the Burma Road Upgrade area includes portions of the Blue Rim Desert Common Allotment (Map 3.22 and Table 3.55). Livestock grazing is allocated to two permittees each in the Stud Horse Common 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.

<u>Blue Rim Desert Common Allotment</u>

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.

<u>Stud Horse Common Allotment</u>

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.

<u>Sand Draw Common Allotment</u>

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.

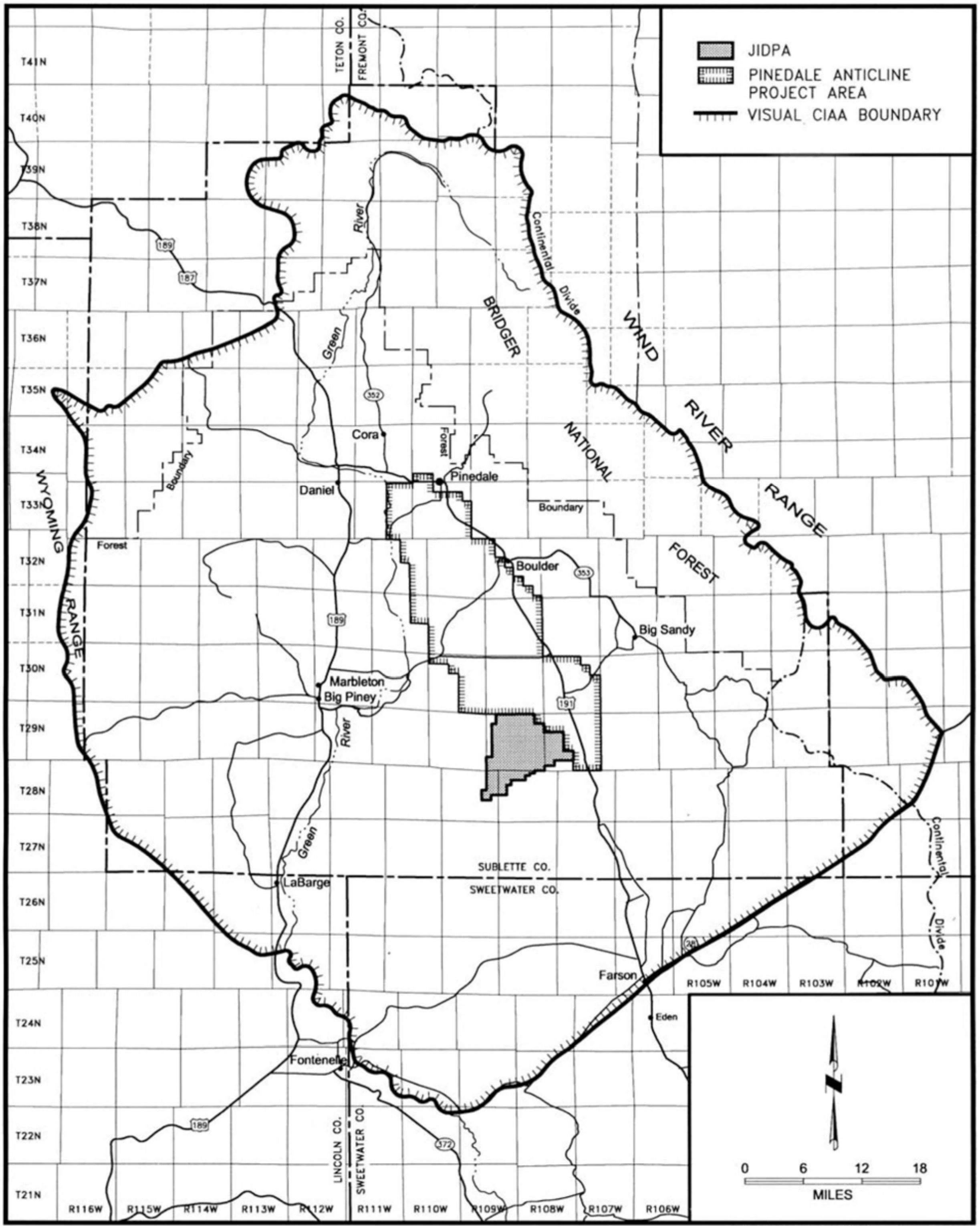
General observations show that light forage utilization is made in the northern portion of this allotment.

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

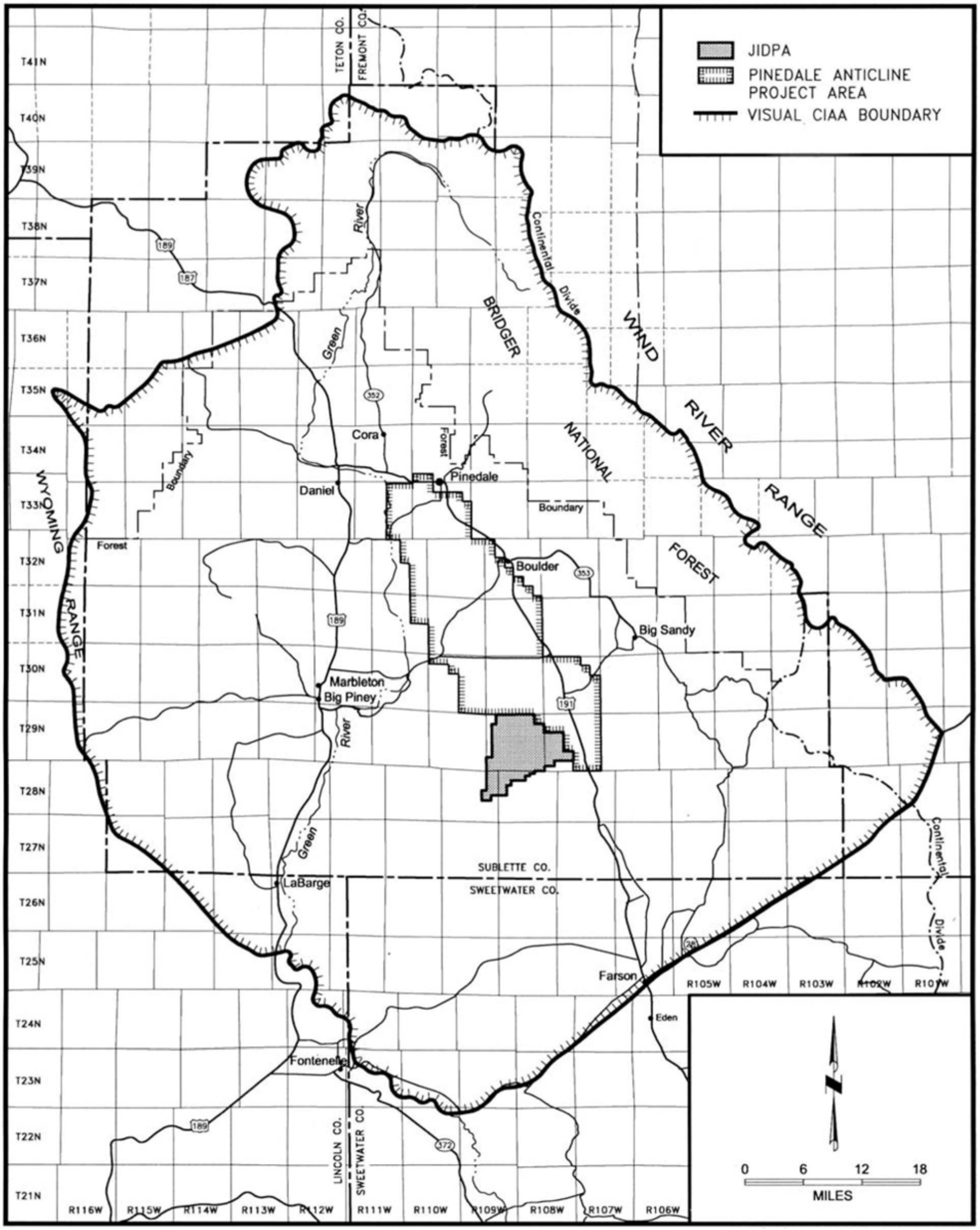
Surface transportation in the JIDPA is provided by an extensive network of collector and resource roads (see Map 2.1 and Appendix B, Subappendix DP-A). The two principal roadways to the JIDPA are State Highway 191, which links the field to Rock Springs and Pinedale, Wyoming, and State Highway 351, which 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.