CHAPTER 3—AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The Pinedale planning area is composed of approximately 922,880 acres of Bureau of Land Management (BLM)-administered public land surface and 1,199,280 acres of federal mineral estate in portions of Sublette and Lincoln counties in southwestern Wyoming. The towns of Pinedale, Boulder, Cora, and Daniel are located in the northern portion of the planning area; Big Piney and Marbleton in the central area; and La Barge in the southern portion. The planning area is located about 100 miles south of Yellowstone National Park. Teton and Bridger National Forests bound the planning area on the north and west, and Bridger National Forest and Bridger Wilderness area bound the area on the east. The Gros Ventre Range is north of the planning area, the Wind River Mountains are on the east, and the Wyoming and Hoback Ranges are on the west. The area varies in elevation from about 6,500 feet in the southwestern corner up to 9,500 feet along some of the mountain fronts. Mesas and buttes form the most common topographic features across most of the planning area.

Most of the planning area lies within the Upper Green River and New Fork River watersheds, with an estimated 300 miles of stream and riverine habitat and 2,500 acres of lake and reservoir habitat supporting diverse wildlife populations. The dominant semiarid steppe climate is characterized by cold winters and short summers. Sagebrush and mountain shrub communities dominate the planning area, with some riparian-, saltbush-, and woodland-dominated areas. The diverse natural communities support a wide variety of game and nongame wildlife and fish species, including several Special Status Species. Hunting and fishing opportunities abound, and other types of recreational opportunities, such as river recreation, camping, and wildlife viewing, are also abundant. The planning area supports a variety of uses, including agriculture, recreation (including commercial outfitting), and, increasingly, oil and gas development.

This chapter describes environmental characteristics, conditions, and trends that influence the resolution of planning issues or that would be affected by the management actions presented in Chapter 2. The status of the current environmental conditions is, in part, a result of the current Pinedale Resource Management Plan (RMP). Environmental components that would not be affected or that are not essential to the resolution of planning issues are not covered in detail. No new environmental data collection efforts were conducted on BLM-administered lands specifically for this RMP.

3.2 AIR RESOURCES

3.2.1 Climate

The climate in the planning area is designated as Southern Rocky Mountain Steppe, a temperate semiarid steppe regime with average annual temperatures ranging from 35 to 45 degrees Fahrenheit (^{o}F) (2 to 7 degrees centigrade [^{o}C]) in most of the region, but reaching 50^{o}F (10^{o}C) in the lower valleys. The prevailing west winds and the general north-south orientation of the mountain ranges influence the climate. East slopes are much drier than west slopes; individual mountain ranges have similar east-west slope differences region-wide. Winter precipitation varies considerably with altitude.

Total precipitation is moderate, but greater than on the plains to the east and west. In the highest mountains, a considerable part of annual precipitation is snow, although permanent snowfields and glaciers cover only relatively small areas. Bases of these mountains receive only 10 to 20 inches (260 to 510 millimeters [mm]) of rainfall per year. At higher elevations, annual precipitation increases to 40 inches (1,020 mm), and average temperatures fall (Bailey 1995).

Weather stations are located in Pinedale (7,175 feet) and Big Piney (6,820 feet) in Sublette County, Wyoming. Meteorological data are available for Pinedale from August 1948 through April 2007 and for Big Piney from 1948 through 2006.

Temperature

Diurnal (morning to night) and seasonal (summer to winter) ranges in temperature are greater in valleys than on slopes (Martner 1986). Mean annual temperatures for Pinedale and Big Piney are 52^{o}F and 53^{o}F, respectively. Mean maximum summer temperatures of 75^{o}F and 76^{o}F and mean minimum winter temperatures of 0^{o}F and 3^{o}F occur in these two towns, respectively (Figures 3-1, 3-2, and 3-3) (Western Regional Climate Center).

Precipitation

High elevations experience greater amounts of precipitation than do lower elevations. The mean annual precipitation is 11 inches in Pinedale and 7.5 inches in Big Piney. The mean annual precipitation ranges from 5 inches in dry years to 19 inches in wet years in Pinedale. The mean annual precipitation in Big Piney ranges from 5 inches in dry years to 12 inches in wet years (Western Regional Climate Center).

Figure 3-4 shows that mean monthly precipitation varies from 0.53 to 1.65 inches throughout the year in Pinedale and from 0.31 to 1.1 inches in Big Piney (Western Regional Climate Center). The mean total snowfall is 2 feet in Pinedale and 1 foot in Big Piney, with most snow occurring from November through April. Figure 3-5 shows that the mean monthly winter snowfall ranges from 6 to 12 inches in Pinedale and from 2 to 4 inches in Big Piney (Western Regional Climate Center).

Trend data across three decades are shown monthly (Figures 3-6 and 3-7) and annually (Figure 3-8). These trends show a slight precipitation increase in Pinedale and a slight decrease in Big Piney (Western Regional Climate Center).

Dispersion

Atmospheric stability is a measure of the atmosphere's capacity to disperse pollutants. Comprehensive wind measurements made closest to the planning area were collected in the Jonah Field Project Area adjacent to the southeast corner of the Pinedale Anticline Project Area (PAPA) at a meteorological station operated by BP from 1999 through 2003. Atmospheric stability class (Table 3-1 and Figure 3-9) is a 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. The frequency and strength of winds greatly affect the transport and dispersion 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 and inhibits air pollutant mixing and transport.

Table 3-1. Atmospheric Stability Class Distribution Averaged from 1999 through 2003

Stability Class*	Frequency (%)
A	2.4
B	6.1
C	12.2
D	60.2
E	15.4
F	3.7

Source: BP 2004.
* A = unstable; D = neutral; F = very stable

Wind Direction and Velocity

Wind speed and direction are highly variable as a result of the effect of local topography in the planning area. Comprehensive wind measurements made closest to the planning area were collected in the Jonah Field Project Area adjacent to the southeast corner of the PAPA at a meteorological station operated by BP from 1999 through 2003. Winds in the PAPA (Table 3-2) are from the west to northwest approximately 40% of the time.

Table 3-2. Wind Direction Frequency Distribution in the Vicinity of the PAPA Averaged from 1999 through 2003

Wind Direction	Frequency (%)
N	5.3
NNE	3.9
NE	3.5
ENE	3.9
E	3.8
ESE	2.9
SSE	2.8
S	3.8
SSW	4.8
SW	6.6
W	9.9
WNW	15.9
NW	14.4
NNW	9.2

Source: BP 2004.

While the annual mean wind speed is 11.2 miles per hour (mph), wind speeds in excess of 19 mph occur more than 12% of the time (Table 3-3).

Table 3-3. Distribution of Wind Speeds in the Vicinity of the PAPA Averaged from 1999 through 2003

Wind Speed (mph)	Frequency (%)
0–4.0	9.1
4.0–7.5	25.4
7.5–12.1	28.1
12.1–19.0	24.7
19.0–24.7	7.2
Greater than 24.7	5.5

Source: BP 2004.

Figure 3-10 shows the occurrence frequency of wind speeds and wind directions for the Jonah Field in Wyoming.

3.2.2 Air Quality Characterization

Elements of air quality addressed in the air quality analysis include concentrations of air pollutants, visibility, and atmospheric deposition. The air quality technical support document provides a summary of applicable air quality regulations (Appendix 19).

3.2.3 Ambient Air Quality Concentrations

Ambient air concentration usually refers to the mass of pollutants present in a volume of air and can be reported in units of micrograms per cubic meter ($\mu g/m^3$). Concentration can also be reported on a volume basis as parts per billion (ppb) and parts per million (ppm). The ambient air quality standards tables in Appendix 19 show both units for comparison. The Wyoming Department of Environmental Quality-Air Quality Division (WDEQ-AQD) determines background air quality levels. Because information collected from the nearest applicable monitoring stations indicates that current concentrations comply with applicable standards, air quality in the planning area is considered good. However, current and complete data on the concentrations of criteria air pollutants for the planning area are not available. The State of Wyoming has used monitoring to determine that the Pinedale region is in compliance with Wyoming Ambient Air Quality Standards (WAAQS) and the National Ambient Air Quality Standards (NAAQS). Table 3-4 shows ambient air concentrations of criteria air pollutants provided by the WDEQ-AQD.

Table 3-4. Ambient Air Background Concentrations for Pinedale

Pollutant/Averaging Time Measured	Measured Background Concentration ($\mu g/m^3$)	Percent of Standards Data		Data Source
		NAAQS	WAAQS	
Carbon monoxide (CO)				
1-hour	1,979	5	5	Data collected in Yellowstone National Park, Wyoming, at the monitoring site near "Old Faithful" during 2005 (Pinedale Anticline Draft Supplemental Environmental Impact Statement [EIS] 2006).
8-hour	931	9	9	
Nitrogen dioxide (NO_2)				
Annual	19.1	6	6	Data collected in the Jonah Field, approximately 40 miles northwest of Farson, Sublette County, Wyoming. Values are based on a partial year of data (January 15 to December 31) collected during 2005.
Ozone				
8-hour	152	97	97	Data collected in the Jonah Field, approximately 40 miles northwest of Farson, Sublette County, Wyoming. Values are based on a partial year of data (January 15 to December 31) collected during 2005.
Particulate matter (PM_{10})[a]				
24-hour	51	34	34	Data collected in the Jonah Field, approximately 40 miles northwest of Farson, Sublette County, Wyoming. Values are based on a partial year of data (January 15 to December 31) collected during 2005.
Annual	10	20	20	
Particulate matter ($PM_{2.5}$)[a]				
24-hour	18	51	51	Data collected in the Jonah Field, approximately 40 miles northwest of
Annual	6.5	43	43	

Pollutant/Averaging Time Measured	Measured Background Concentration ($\mu g/m^3$)	Percent of Standards Data		Data Source
		NAAQS	WAAQS	
				Farson, Sublette County, Wyoming. Values are based on a partial year of data (January 15 to December 31) collected during 2005.
Sulfur dioxide (SO_2)				
3-hour	93	7	13	Data collected at the Lost Cabin Gas Plant Preconstruction Monitoring in Fremont County 1986–1987
24-hour	32	9	12	
Annual	4	1	1	

[a] On September 21, 2006, the Environmental Protection Agency (EPA) announced final revisions to the NAAQS for particulate matter. The revision strengthens the 24-hour PM2.5 standard from 65 to 35 $\mu g/m^3$ and revokes the annual PM10 standard of 50 $\mu g/m^3$. EPA retained the existing annual PM2.5 standard of 15 $\mu g/m^3$ and the 24-hour PM10 standard of 150 $\mu g/m^3$. The final rule has not yet been published in the *Federal Register* and is not effective until 60 days after publication in the *Federal Register*. After the final rule becomes effective, the State of Wyoming will enter into rulemaking to revise the WAAQS.
Note: Units in micrograms per cubic meter ($\mu g/m^3$).

Carbon Monoxide

Because carbon monoxide (CO) data are collected mostly in urban areas where automobile traffic levels are high, recent data are often unavailable for rural areas. CO concentrations measured in the Jonah Field, approximately 40 miles northwest of Farson, Sublette County, Wyoming, based on values from a partial year of data (January 15 to December 15) in 2005 were less than 10% of the WAAQS and NAAQS.

Nitrogen Dioxide

Nitrogen dioxide concentration data collected at the Jonah Field site from January 15 to December 31, 2005 were 6% of the WAAQS and NAAQS.

Sulfur Dioxide

Sulfur dioxide (SO_2) concentrations measured at the Jonah Field site in 2005 were less than 15% of the WAAQS and NAAQS.

Ozone

Ozone (O_3) concentration data were collected at the Jonah Field site from January 15 to December 31, 2005. O_3 concentrations were 97% of the WAAQS and NAAQS air quality 8-hour standard (Table 3-4). However, recent data collected at Boulder indicate that the 8-hour rolling average for ozone for the fourth highest value of 0.079 ppm would exceed the new EPA standard (0.075 ppm). These data are consistent with other recently collected ozone data in Wyoming and Utah, indicating potential issues with meeting the new short-term 8-hour standard.

O_3 levels of concern (LOC) have been estimated for several areas, including the Bridger Wilderness in Wyoming (Fox et al. 1989). Estimated total deposition LOCs include the "red line" (defined as the O_3 concentration that the area can tolerate) and the "green line" range (defined as the acceptable level of O_3). O_3 LOCs for Bridger include the green line (set at 75–35 ppb/year) and the red line values (set at 65–120 ppb/year).

The Clean Air Status and Trends Network (CASTNet) stations in Pinedale, Yellowstone National Park, and Boulder also collected O_3 data. Figure 3-11 shows that mean annual O_3 concentrations remained steady from 1989 through 2006 and are typical for remote areas in the western United States (Singh et al. 1978) and are within the LOCs as the acceptable level of O_3 ("green line" range).

More recently, ozone data have been collected at three monitoring sites in the area beginning in 2005. These stations recorded elevated ozone levels during 2005, 2006, and 2008 (Table 3-5). The elevated ozone levels have been recorded during the winter months, primarily in February, which is an atypical time compared with other areas of the country where elevated ozone levels have been observed. Typically, ozone is thought to be a summertime problem in urban areas. Elevated ozone concentrations are uncommon during the winter months; however, the data collected at the three monitoring stations do not appear to be an anomaly because these conditions were recorded in February 2005, 2006, and 2008. There are several hypotheses regarding the cause(s) of these elevated ozone events, including stratospheric ozone intrusion, ozone transport from other areas, and a combination of unique meteorological, land surface, and topographical conditions acting upon local scale emissions.

Table 3-5. Maximum Measured 8-hour Ozone Concentrations for 2005–2006

Monitor	Rank	Ozone Concentration (ppm)			
		2005	2006	2007	2008[1]
Jonah Field	1st	0.098	0.093	0.071	0.102
	2nd	0.089	0.081	0.07	0.098
	3rd	0.078	0.072	0.069	0.084
	4th	0.076	0.07	0.069	0.082
Boulder	1st	0.089	0.081	0.072	0.122
	2nd	0.082	0.079	0.068	0.104
	3rd	0.081	0.076	0.068	0.102
	4th	0.08	0.073	0.067	0.101
Daniel	1st	0.071	0.083	0.068	0.076
	2nd	0.067	0.076	0.068	0.076
	3rd	0.067	0.075	0.067	0.074
	4th	0.067	0.075	0.067	0.074

[1] The 2008 data is only for the first quarter of 2008.

Particulate Matter

Mean annual particulate matter (PM_{10}) concentrations collected at the Jonah Field, Wyoming, were 20% of the NAAQS and WAAQS, and 24-hour $PM_{2.5}$ concentrations were 51% of the NAAQS and WAAQS (Table 3-4).

Hazardous Air Pollutants

Hazardous air pollutants (HAP) ambient concentration data do not exist for the planning area. There are no ambient air quality standards for HAPs. WDEQ-AQD regulates HAP emissions through the New Source Review permitting process and applicable national emissions standards for hazardous air pollutants (NESHAP) maximum achievable control technology (MACT) standards. However, the impact analysis in Chapter 4 addresses HAP emissions.

Visibility

Interagency monitoring of protected visual environments (IMPROVE) has measured visibility in national

parks and wilderness areas in the United States since the 1980s. There are five IMPROVE aerosol monitoring stations in Wyoming: Bridger Wilderness (near Pinedale), Yellowstone National Park, North Absaroka Wilderness (near Dead Indian Pass), Cloud Peak, and Thunder Basin. Some of the best visibility monitored in the contiguous United States is at the Bridger Wilderness station in western Wyoming. Visibility can be expressed in deciviews (dv), a measure of perceived changes in visibility. One dv is defined as a change in visibility that is just perceptible to an average person, about a 10% change in light extinction.

Monitored aerosol concentrations are used to reconstruct visibility conditions for each day monitored, ranked from clearest to haziest; conditions are reported in three categories:

- 20% clearest—Mean visibility for the 20% of days with the best visibility
- Average—Annual mean visibility
- 20% haziest—Mean visibility for the 20% of days with the poorest visibility.

Figure 3-12 shows annual visibility in Bridger Wilderness from 1988 through 2003 (using the most current data available from IMPROVE). Visibility on the 20% cleanest days varies from 2.7 to 4.5 dv (visual range of about 155–175 miles). Average visibility varies from 6.4 to 7.7 dv (about 112–128 miles). Visibility for the 20% haziest days varies from 9.9 to 12.3 dv (about 71–90 miles). The Bridger IMPROVE station was sited to monitor general air quality representative of the Bridger area, rather than the maximum impact from gas development.

In addition, for comparison, Figure 3-13 provides the reconstructed fine mass data (1-year average) for Bridger Wilderness from 1989 through 2003.

Atmospheric Deposition

Atmospheric deposition, which refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, is reported in the document as the mass of material deposited on an area in 1 year (kilogram per hectare per year [kg/ha/yr]). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling of particles and adherence of gaseous pollutants to soil, water, and vegetation). The following substances are deposited:

- Acids—Such as sulfuric acid (H_2SO_4) and nitric acid (HNO_3). This acid deposition is sometimes referred to as acid rain.
- Air toxics—Such as pesticides, herbicides, and volatile organic compounds (VOC).
- Nutrients—Such as NO_3^- and NH_4^+.

The estimation of atmospheric deposition is complicated by contributions to deposition by rain, snow, cloud water, particle settling, and gaseous pollutants. Deposition varies with precipitation, which, in turn, varies with elevation and time.

Wet Deposition

The National Atmospheric Deposition Program (NADP) assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). The natural acidity of rainwater is represented by a range of pH values from 5.0 to 5.6 (Seinfeld 1986). The mean annual pH in Pinedale (Figure 3-14) from 1982 through 2006 ranged from 4.9 to 5.7, indicating some acidification of precipitation during that period. Data for Gypsum Creek and South Pass show higher pH values in the range of acidity of rainwater.

Figures 3-15, 3-16, and 3-17 show the mean annual wet deposition of NH_4^+, NO_3^-, and SO_4^- at Pinedale, Gypsum Creek, and South Pass NADP stations, respectively, from 1980 through 2006. These values are

generally low for both Pinedale and Gypsum Creek, although wet depositions of sulfate values were as high as 4 kg/ha/yr in 1984 for Pinedale and in 1989 for South Pass.

Sometimes monitoring data are not available because of problems with collecting or analyzing samples. For more information on data collection criteria, refer to Appendix 19.

Dry Deposition

Dry deposition refers to the transfer of airborne gaseous and particulate material from the atmosphere to the Earth's surface. The CASTNet measures dry deposition of SO_2, HNO_3, SO_4, NO_3, and NH_4. These data for Pinedale and Yellowstone National Park (Figures 3-18) show dry deposition values in Pinedale to be low and steady for all pollutants, although HNO_3 deposition ranged from 0.75 to 2.5 kg/ha/yr in Pinedale.

The two CASTNet[1] stations that monitor nitrogen compounds most pertinent to the planning area (Pinedale) have data available for 1989 through 2006 (Figures 3-19). Mean annual concentrations of HNO_3 are less than 0.2 ppb in Pinedale. Typically, HNO_3 concentrations range from 0.02 to 0.3 ppb in remote areas and from 3 to 50 ppb in urban areas (Seinfeld 1986). Although HNO_3 concentrations in Pinedale are well below urban levels, concentrations are in the high range of those typical in remote areas. Mean annual concentrations of nitrate (NO_3^-) are less than 0.1 ppb at Pinedale. Typically, NO_3^- concentrations are about 0.2 ppb in remote areas and 1 ppb in urban areas (Stern 1973). Mean annual concentrations of ammonium (NH_4^+) are less than 0.4 ppb in Pinedale. Typically, NH_4^+ concentrations are 0.3 ppb in remote areas and 1.4 ppb in urban areas (Stern 1973).

Weekly concentrations of NO_3^- and NH_4^+ measured by the Wyoming Air Resources Monitoring System (WARMS) at Pinedale in 2000–2002 are below 1.5 $\mu g/m^3$ for NO_3^- and below 0.6 $\mu g/m^3$ for NH_4^+ (Figures 3-20 and 3-21).

More recent SO_2 data, as well as sulfate (SO_4^{--}) data, were collected by CASTNet in Pinedale through 2006 (Figure 3-22). Concentrations of SO_2 are less than 0.3 ppb in Pinedale. Typically, SO_2 concentrations range from 1 to 10 ppb in remote areas and from 20 to 200 ppb in urban areas (Seinfeld 1986). Thus, SO_2 concentrations in the planning area region are less than concentrations typical of remote areas. Mean annual concentrations of SO_4^{--} are below 0.1 ppb in Pinedale. Typically, SO_4^{--} concentrations are about 0.6 ppb in remote areas and about 2.5 ppb in urban areas (Stern 1973). Thus, SO_4^{--} concentrations in the planning area region are well below urban levels and equal to levels typical in remote areas.

Figures 3-23 and 3-24 show weekly WARMS concentrations of SO_2 and SO_4^{--} in Pinedale from mid-1999 through 2006 to be about 1.7 $\mu g/m^3$ or less. It would be inappropriate to compare weekly WARMS concentrations directly with mean annual concentrations.

Total Deposition

Total deposition refers to the sum of airborne material transferred to the Earth's surface by both wet and dry deposition (see calculations below for details). Total deposition LOCs have been estimated for several areas, including the Bridger Wilderness in Wyoming (Fox et al. 1989). Estimated total deposition LOCs include the "red line" (defined as the total deposition that the area can tolerate) and the "green line" (defined as the acceptable level of total deposition). Total nitrogen deposition LOCs for Bridger include the red line (set at 10 kg/ha/year) and the green line (set at 3–5 kg/ha/year). Total sulfur deposition LOCs for Bridger include the red line (set at 20 kg/ha/year) and the green line (set at 5 kg/ka/year). The U.S.

[1] Because of the chemistry of nitrogen- and sulfur-containing compounds and the manner in which data are collected, it would not be appropriate to compare CASTNet and WARMS data with ambient air quality standards. In addition, there are questions concerning the lack of consistency in the WARMS data.

Forest Service (USFS) does not believe these current LOCs (3 kg/ha/year for total N and 5 kg/ha/year for S) to be protective. In fact, the USFS Pinedale District Office has proposed that the LOC for total N deposition be strengthened to 1.5 kg/ha/year (Baron 2006).

Figures 3-25 and 3-26 compare total deposition near Pinedale with the total deposition LOCs set for the Bridger Wilderness. Total nitrogen deposition near Pinedale has been equal to or lower than the Bridger Wilderness LOCs from 1982 through 2006. Total sulfur deposition has been well below both LOCs for the same period.

3.2.4 Summary of Existing Air Quality

Air quality monitoring data provided by the State of Wyoming show that air quality in the Pinedale region is in compliance with state and federal ambient air quality standards (Table 3-6).

Table 3-6. Summary of Air Quality Values for the Planning Area

Air Quality Component	Comment
Air Pollutant Concentrations	
Criteria air pollutants	• Concentrations are in compliance with NAAQS and WAAQS.
Nitrogen compounds	• HNO_3 concentrations in Pinedale are consistent with concentrations in other remote areas. • Concentrations of NO_3 and NH_4 in Pinedale are consistent with other remote areas.
Sulfur compounds	• SO_2 concentrations in Pinedale are below concentrations typical in remote areas. • SO_4^{--} concentrations in Pinedale are below concentrations typical in remote areas.
Visibility	
Bridger Wilderness	• 20% cleanest: 155–175 miles • Average: 112–128 miles • 20% haziest: 71–90 miles
Atmospheric Deposition	
Precipitation pH	• Slight precipitation acidification in Pinedale from 1994 through 2006 (pH as low as 4.9)
Total deposition	• Pinedale: nitrogen deposition from ammonium (NH_4^+) and nitrate (NO_3) is less than 2.0 kg/ha/yr. Sulfur deposition from sulfate ($SO4^{--}$) and sulfur dioxide (SO_2) is less than 1.7 kg/ha/yr.

3.2.5 Global Climate Change

Ongoing scientific research has identified the potential impacts of greenhouse gas (GHG) emissions (including CO_2, methane [CH_4], nitrous oxide [N_2O], water vapor, and several trace gases) on global climate. Through complex interactions at regional and global scales, these GHG emissions cause a net warming effect of the atmosphere (which makes surface temperatures suitable for life on Earth), primarily by decreasing the amount of heat energy radiated by the Earth back into space. Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), recent industrialization and burning of fossil carbon sources have caused CO_2 concentrations to increase dramatically and are likely to contribute to overall climatic changes, typically referred to as global warming. Increasing CO_2 concentrations also lead to preferential fertilization and growth of specific plant species.

Global mean surface temperatures have increased nearly 1.0°C (1.8°F) from 1890 to 2006 (Goddard

Institute for Space Studies, 2007). However, observations and predictive models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Figure 3-27 shows data indicating that northern latitudes (above 24° N) have exhibited temperature increases of nearly 1.2°C (2.1°F) since 1900, with nearly a 1.0°C (1.8°F) increase since 1970 alone. Figure 3-28 shows average temperature (AT) and precipitation (PPT) trends for the conterminous United States. For both parameters, varying rates of change have occurred, but overall, there have been increases in both AT and PPT. Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions, but increasing concentrations of GHG are likely to accelerate the rate of climate change.

In 2001, the Intergovernmental Panel on Climate Change (IPCC) pointed out that by the year 2100, global average surface temperatures would increase 1.4 to 5.8°C (2.5 to 10.4°F) above 1990 levels. The National Academy of Sciences (2006) confirmed these findings but also indicated that there are uncertainties regarding how climate change may affect different regions. Computer model forecasts indicate that increases in temperature will not be evenly or equally distributed but rather are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures are more likely than increases in daily maximum temperatures.

Several activities occur within the planning area that may generate GHG emissions. Oil and gas development, large fires, and recreation using combustion engines can potentially generate CO_2 and methane.

3.2.6 Cooperative Air Quality Management

The State of Wyoming has primacy with regard to air quality. Adhering to WDEQ standards is required by law. Air quality standards are maintained by the State of Wyoming, which determines the necessity of regulating emissions. When necessary, the state regulates emissions through its State Implementation Plan (SIP) for air quality by promulgating the appropriate rule. BLM strives to minimize, within the scope of its authority, any emissions that may add to atmospheric deposition, cause violations of air quality standards, or degrade visibility. The EPA provides oversight responsibility during this process and has approval authority over the State of Wyoming SIP. State standards enforced in the planning area must be as strict as or stricter than federal standards.

BLM helps support interagency efforts, such as IMPROVE stations and remote automated weather stations (RAWS), and directly funds the WARMS network.

3.3 CULTURAL RESOURCES

3.3.1 Cultural Resource Types

The planning area contains a diverse range of cultural resources. The primary types of prehistoric, historic, and Native American cultural resources present in the planning area are described below.

Prehistoric Cultural Resources

A variety of classes of prehistoric archeological remains are represented in the planning area. Locations containing one or more cultural features such as fire pits, remains of structures, stone alignments, and/or two or more artifacts, typically are classified as archeological sites, whereas individual artifacts scattered across the landscape typically are recorded as isolates. Different site types typically are defined by the types of remains that they contain and/or the topographic contexts in which they occur, both of which may be indicative of different prehistoric uses, different prehistoric time periods, or a variety of other factors. They range in size, complexity, and sensitivity from large complexes covering many acres and containing dense, diverse, and sensitive remains to a couple of individual surface artifacts.

The most prevalent archeological remains in the planning area are various types of fire and baking pits, discarded cooking rock, flaked stone tools and waste flakes, and animal bone fragments. When two or more of these classes co-occur at a given location, the location is typically classified as a campsite. Campsites also less frequently contain stone grinding tools, pottery fragments, beads, and other domestic items, as well as more complex types of cultural features, including stone circles, house pits and the remains of other house structures, more formalized cooking pits, and specialized activity areas characterized by dense concentrations of remains such as bone fragments associated with a specialized activity. Campsites are also differentiated according to whether they occur in open contexts, in sheltered contexts (e.g., adjacent to a bedrock face), or under bedrock overhangs (rock shelters). Sites that contain only flaked stone artifacts or sometimes discarded cooking rock are classified as lithic scatter sites, although many lithic scatters may also represent the remains of brief camps.

Open campsites and lithic scatters compose the majority of prehistoric archeological sites in the planning area and the western Wyoming Basin in general. Both site types occur in a wide variety of topographic, ecological, and depositional contexts, and the general site types mask a wide range of functional and temporal variability. A large proportion of the open camps are limited to one or a few fire pits with only a few associated waste flakes and/or scraps of animal bone reflecting brief occupations or collections of such features and associated remains that accumulated as a result of the reuse of the same location over a period of decades, centuries, or even millennia. Particularly desirable locations, however, can contain very extensive, very dense concentrations of remains resulting from longer occupations and/or particularly heavy reuse over extended periods of time. The latter sites are especially common in sand dune complexes, for example, in the southwestern planning area, and in distinctive bedrock outcrop areas in or along the edges of interior basin areas.

Other campsite types are defined by the presence of distinctive habitation features, most notably house pits and domestic stone circles. House pits typically consist of large, shallow basins that are interpreted as the remains of ephemeral, informal house structures of a sort built by mobile hunter-gatherers. They typically exhibit very simple construction. The evidence suggests that they were simply shallow basins or even merely spatially circumscribed areas covered with some sort of simple brush and/or hide superstructure. They typically contain interior hearths and/or cooking pits. Most have only limited associated artifacts and other remains. They date primarily to the early middle period of human occupation in the region. Although sites with house pits are relatively uncommon in the planning area, they compose a prominent and important element of the archeological record of the area because of the relatively broad range of information that they can provide concerning prehistoric human lifeways in the

region.

Stone circle sites are relatively common in some parts of the planning area. Most of the stone circles in the area are interpreted as rocks that were used to secure the bases of tipis or other light superstructures (i.e., as tipi rings). They occur mostly on high ridges or benches and may include anywhere from one to a maximum of a dozen stone circles. The ages of stone circle sites are often difficult to ascertain, but many may be predominantly a late (post-1,000 years B.P.) phenomenon in the planning area. The relative abundance of stone circle sites distinguishes the planning area from the rest of the Green River Basin. Other aboveground stone features, such as cairns and rock alignments, are often associated with stone circle sites. The planning area also contains a variety of other types of rock features, including medicine wheels and other circular stone alignments of possible ceremonial significance, isolated cairns and lines of cairns (some of which may have served as trail markers), game drive lines, and small stone structures that may represent hunting blinds and vision quest structures. Most features and feature complexes occur on higher ridges and other prominences. They sometimes occur in association with stone circles but also occur separately. Traditional, modern day Native Americans frequently consider stone circles and other alignment sites as sensitive, "respected areas" as well as stone cairns, rock alignments, drive lines, and similar stone features.

Other site types correspond to more specialized activity. They include animal kill and butchering sites, plant processing locales, and tool stone source areas. Two particularly prominent animal kill and processing sites—the Wardell site and the Trappers Point site—have been excavated in the planning area. The Wardell site was a communal bison trapping site near the Green River (Frison 1991), which was used over a period of approximately 500 years beginning about 1,580 years B.P. The site includes the remains of a bison trap, a dense bison bone bed, and an adjacent large butchering, processing, and camp area. Smaller bison kill and butchering sites are also known in the planning area, but in general, they appear to be rare. The Barnes Site (48LN350) is a similar communal kill site containing bison remains; however, Barnes is a jump site, whereas Wardell is a trap site. The Trappers Point site is situated along a bottleneck in a major pronghorn migration route between summer and winter ranges and exhibits evidence of the intensive procurement and processing of pronghorn between approximately 6,000 and 5,300 years B.P. (Miller et al. 1999). The excavated portion of the site encompasses a bone bed associated with a processing area. It is estimated to contain bone from more than 100 individual pronghorn. It is possible that other similar pronghorn kill and processing sites are present in the planning area, both in the Trappers Point area and at other strategic points along the migration corridor.

The most prominent plant processing locales in the planning area consist of cobble-filled pits interpreted as the remains of features used to bake roots for use as food sources. Francis (1995) estimates the presence of thousands of such features along the margins of the Upper Green and New Fork River valleys. Their use apparently spanned a significant part of the total prehistory of the region. Deep slab-lined and unlined pits that occur in sand dune sites, especially in the southwestern part of the planning area, are also typically interpreted as having been used to bake root foods.

Tool stone source areas in the planning area include bedrock sources from which the tool stone material was eroded or quarried and secondary sources consisting of broad surfaces of redeposited cobbles of tool stone material. Typically, sites associated with tool stone sources include dense scattering of stone waste flakes and broken early-stage manufacture debris associated with the initial reduction of the tool stone material. Prominent known bedrock tool stone sources with associated prehistoric sites include Site 48SU345 near the town of Boulder and the Site 48SU337, a procurement site complex north of the Jonah gas field. Secondary tool stone sources tend to be much more extensive and are often dealt with as lithic procurement landscapes. Two lithic landscapes—the Mesa and Yellow Point Ridge Lithic Landscapes—have been defined in the planning area to date (Lubinski 1998). Because artifactual material associated with lithic landscapes usually is widely dispersed and of limited complexity, such landscapes are typically considered to possess little significance as archeological resources.

Other important and particularly sensitive classes of prehistoric sites also occur in the planning area, including rock art sites and human interments. The number of prehistoric rock art sites in the planning area is relatively limited, and the sites tend to be small; new rock art sites continue to be discovered (Tanner and Vlcek 1995; Vlcek n.d.). The rock art consists primarily of incised petroglyphs, but one site with painted pictographs has been identified. Human interments encountered to date have taken two primary forms—bundle burials in pits associated with house pit sites and skeletal remains reflecting crevice or scaffold burials. All Native American burials, as well as stone circles, are considered sensitive, "respected areas" by traditional, modern day Native Americans, as typically are stone cairns, rock alignments, drive lines, and similar stone features.

Finally, sites in the area are also sometimes classified in terms of the time periods represented, types of artifacts present, or the distinctive contexts in which they occur. This is particularly common with regard to sites dating to the Paleoindian period, sites containing ceramics, and dense clusters of sites associated with distinctive landform contexts. The latter includes, for example, numerous sites or loci of archeological material associated with large dune complexes. Other instances include clusters of sites and loci of archeological remains associated with a distinctive bedrock outcrop area, a prominent playa, and large complexes of disparate but interrelated stone features. Typically, such collections of sites are conceptualized as site complexes, but in one instance have been defined as a formal archeological district (Site 48SU4000). The Trappers Point area and the ridges surrounding 48SU285 also potentially qualify as formal archeological districts.

Historic Cultural Resources

A significant number of the total recorded sites in the planning area are historic archeological sites. As with prehistoric resources, they range from large, prominent resources, such as the Lander Cutoff of the Emigrant Trail or prominent historic ranches, to scatters of a few cans.

Because of the identifiable complexity of historic activities, a large variety of classes of historic archeological remains is represented in the planning area. They include sites related to various themes or contexts described above, from the early fur-trapping industry to the recent oil and gas development. As with prehistoric cultural resources, locations containing one or more historic cultural features such as buildings, roads, trash dumps, and the like or several historic artifacts are typically classified as archeological sites, and individual artifacts or small numbers of historic artifacts scattered across the landscape typically are recorded as isolates.

The most common historic archeological site types encountered in the planning area are those associated with ranching activities. Most of the historic ranch complexes are on private land and typically are not dealt with in the context of federal land management activities. Typically, they date from the 1880s to 1920s. However, a number of ancillary site types are frequently encountered on federal lands. The more prominent of such sites include line camps, corrals, windmills, irrigation ditches, fence lines, sheepherder monuments and rock cairns, and potentially stock driveways (SDW) (including the Green River Drift). However, by far the most common archeological sites encountered are trash scatters that were associated with stock herding camps.

Historic trails and roads are another prominent historic site type in the planning area because of the particular historic prominence of some of the resources, such as the Lander Trail and the Sublette Cutoff of the Emigrant Trail (Map 3-1), and because their length often makes them difficult to avoid in the context of development activities. In addition to the more prominent trails, there are the early Opal and New Fork wagon roads; early 20th century automobile routes (including bridges); and potentially various other historic trails and routes used by Native Americans, explorers, and other early historic inhabitants of the region. Related sites include camps, historic inscriptions (on both wood and rock), graves, and possibly route markers.

Another site-type theme is historic oil and coal mining, particularly in the LaBarge area. Sites potentially

associated with this site type include historic oil field camps and associated ancillary facilities; historic coal mine complexes, including associated residential structures; historic oil well locations and oil field equipment; roads; and a variety of features produced as a result of construction or maintenance of wells.

Other prominent historic site types in the planning area include fur trade and rendezvous-related sites along the Green River; early camp and town site locations, such as Fort Bonneville and the original New Fork town site; tie hacks and other logging remains, such as flumes; and Civilian Conservation Corps camp remains.

Several potential rural historic landscapes could be defined within the planning area. They include the complex of Emigrant Trail historic resources near Names Hill, a historic LaBarge oil field landscape, and a historic rural ranching landscape associated with the early ranches and ranching complexes along the Green and New Fork Rivers. This latter rural historic landscape is composed of historic ranches of private ownership with little to no BLM managerial involvement.

Native American Cultural Resources

Cultural resources within the planning area that are considered sensitive and potentially sacred to modern Native American tribes include burials, rock art, rock features and alignments (such as stone circles, cairns, and medicine wheels), trails, and certain religiously significant natural landscapes and features. These resources may be formally designated as traditional cultural properties (TCP). Other sites may be considered sacred, sensitive, or of importance (e.g., collecting areas) to modern Native Americans. TCPs are recognized as places rooted in a tribe's history or are important in maintaining the continuing cultural identity of a tribe, and as such, they meet the criteria for National Register of Historic Places (NRHP) eligibility. Ceremonial areas used by Native American practitioners are one class of locales that may qualify as a TCP. Native American groups consider several areas within the planning area as qualifying as TCPs.

3.3.2 Cultural Resource Subregions

Cultural resources are not distributed evenly across the planning area. Different areas contain different densities, types, and sensitivities of sites as a function of differences of geographic location, topographic and ecological context, and other factors. TRC Mariah Associates (2006) defined 15 cultural resource subregions to more adequately characterize the nature and sensitivity of the resource base within different portions of the overall planning area. They are the Anticline South, Bench Corral, Deer Hills, Jonah, LaBarge Uplift, River-related, Ryegrass, South Desert, South LaBarge/Miller Mountain, Square Top, The Mesa, Trappers Point/Cora Butte, Upper Green/Beaver Ridge, Wind River Front, and Wyoming Range Front subregions (Map 3-2).

The amount of professional cultural resource management (CRM) work in the different subregions has varied greatly in proportion to the amount of oil and gas development. Before the mid-1990s, the vast majority of CRM in the planning area was conducted in the LaBarge Uplift subregion. Since the mid-1990s, however, the Jonah subregion has become the focus of the greatest amount of work, and the Deer Hills, Anticline South, Square Top, and Mesa subregions have received greatly increased examination. Other subregions such as the Ryegrass, South LaBarge, and River-related remain minimally studied and poorly documented.

Expected cultural resource densities and sensitivities vary significantly among subregions. Subregions that contain especially high densities of significant prehistoric cultural resources include the LaBarge Uplift, Deer Hills, Jonah, South Anticline, and Upper Green River/Beaver Ridge subregions. Subregions that may contain low densities of significant prehistoric sites include Bench Corral, Ryegrass, and South Desert.

The LaBarge Uplift and Deer Hills subregions are characterized by dense, diverse prehistoric cultural

resources that include major sites associated with sand dune complexes, including the Harrower and Birch Creek sites; abundant stone circle sites, cairns, and rock feature complexes; the largest concentration of prehistoric rock art sites; and four prehistoric burials. Black Canyon seems to contain especially high concentrations of prehistoric sites. In contrast with the Jonah and South Anticline subregions, the LaBarge Uplift and Deer Hills subregions contain primarily cultural resources postdating 6,000 years B.P., including numerous Late Prehistoric period sites. The dune complex sites tend to be data rich because of the preservation context and intense prehistoric use of the dunes themselves. Development activities in the vicinity of such sites also tend to result in a high proportion of unanticipated discoveries.

The Jonah and South Anticline subregions are regionally and perhaps even nationally distinctive because of the abundance of prehistoric resources dating to the earlier part of the Early Archaic period, including an abundance of very early houses predating 6,000 years B.P. The early material in the Jonah subregion is associated with San Arcacio soils, particularly in Sand Draw. However, equally early material appears to occur frequently in association with San Arcacio-like soils in the South Anticline subregion and possibly the adjacent Square Top subregion. Development activity in areas containing San Arcacio and San Arcacio-like soils leads to frequent significant unanticipated discoveries because of the lack of surface expression of many or most of the sites. The Jonah subregion also contains Site 48SU4000, an extensive archeological district characterized by a unique concentration of Late Prehistoric period material, and it appears to have good potential to contain intact Paleoindian period components.

The Upper Green River/Beaver Ridge subregion includes the Trappers Point site pronghorn trapping and butchering complex, a rock alignment complex noted on many ridgetops and buttes, numerous prehistoric campsites and plant processing localities associated with river terraces, and Paleoindian and pottery sites.

Subregions that contain especially high concentrations of significant historic properties include Jonah, the Upper Green River/Beaver Ridge, River-related, LaBarge Uplift, and South LaBarge subregions.

In addition to their rich concentration of prehistoric resources, the Upper Green River/Beaver Ridge and River-related subregions include rich historic resources associated with the fur trade era and early exploration of the area. Six of the 16 recognized rendezvous took place at the foot of (and on) Trappers Point. In recognition of that fact, the junction of Horse Creek and the Green River was designated as the Green River Rendezvous National Historic Landmark. Other outstanding rendezvous-related historic sites in the Trappers Point area include the Fr. DeSmet Monument, listed on the NRHP, at the location where, in 1840, the first Catholic Mass in what was to become Wyoming took place. Adjacent to the Fr. DeSmet Monument lies Pinkney Sublette's grave. Pinkney Sublette was one of the famous Sublette brothers (Milton, Bill Sublette) of American Fur Company fame. Fort Bonneville, built and occupied by Captain L.E. Bonneville in 1832, lies 4 miles upstream on the Green River from the DeSmet Monument. It is also listed on the NRHP. Interspersed among these important sites lie the rich bottomlands and drier uplands of the Green and New Fork Rivers, where the actual rendezvous took place. The Trappers Point bottleneck also comprises a key location along the Green River drift, a key element of the Green River historic ranching landscape.

The LaBarge Uplift and South LaBarge contain a number of significant historic properties. The South LaBarge subregion includes a short segment of the Sublette Cutoff of the Oregon Trail, as well as the historic trail-related Names Hill/Holden Hill complex. It also contains a number of ranching-related properties, including cow camps and line shacks that compose elements of a distinctive ranching landscape. The LaBarge Uplift contains the historic LaBarge/Big Piney oil field and related properties, such as Calpet, as well as historic coal mines.

Subregions that contain especially high concentrations of potentially sensitive Native American properties include the LaBarge Uplift and Mesa subregions. The LaBarge Uplift contains the greatest concentration of rock art sites in the planning area (and possibly in the Green River Basin), abundant stone circles, cairns, rock alignments, and burials. Rock art is also common in the adjacent South LaBarge subregion, and stone circles and other stone features are common in much of the western planning area, including the

Deer Hills and Ryegrass subregions. Historic Native American trails are also known to have been present in the Wyoming Range Front subregion. The Mesa subregion contains stone circles and a number of burials in a distinctive context.

3.3.3 Cultural Resource Management Use Allocations

Pursuant to BLM Information Bulletin 2002-101, all cultural resources in the planning area must be allocated to a use category. These categories include—

a—Scientific Use
b—Conservation for Future Use
c—Traditional Use
d—Public Use
e—Experimental Use
f—Discharged from Management.

The majority of significant cultural resources in the planning area are allocated to category a, Scientific Use, because this pertains to most historic and prehistoric archeological resources that are evaluated for nomination to the NRHP under 36 Code of Federal Regulations (CFR) §60.4, criterion D. NRHP-eligible cultural properties of this type are significant for the scientific information they contain. These sites are preserved until their research potential is realized, generally through data recovery investigations. Examples of sites in this category in the planning area include the Birch Creek, Harrower, Deer Hills, J. David Love, and Mckeva Ryka sites.

Cultural resources in category b, Conservation for Future Use, include significant properties deemed worthy of segregation from all other land or resource uses, including cultural resource uses, which threaten the maintenance of present conditions or setting. Properties assigned to this category remain in this use category until specified provisions are met in the future. Properties in the planning area allocated to this use category include portions of Site 48SU4000, the Trappers Point Area of Critical Environmental Concern (ACEC); portions of the Boulder Lake Archeological District and the Green River Drift; Sites 48LN300, 48LN350, 48SU2019, 48SU4100, 48SU285, and 48SU354; and all rock art sites.

Cultural resources in category c, Traditional Use, include those properties that are important to the identity, heritage, or well-being of specific social or cultural groups. In the planning area, this use category pertains mainly to Native American sensitive sites and TCPs. Specific properties allocated to Traditional Use in the planning area include Sites 48SU285, 48SU2019, 48SU3100, and 48SU4100; the Calpet Rock Shelter; all the rock art sites; and several additional confidential sites.

Category d, Public Use, includes cultural properties appropriate for interpretive, educational, or recreational uses by the public. In the planning area, these would include the Lander Trail and Sublette Cutoff, the Wardell Buffalo Trap, and potentially the Calpet Rock Shelter. Scientific information has been recovered at the Calpet Rock Shelter through full recordation of the rock art and excavation of the shelter. Category d also includes the Fr. DeSmet site and Horse Creek Overlook (including Site 48SU1187), Trappers Point interpretive site, Kid's Dig site, portions of the Lander Trail, the Lander Trail/New Fork River Crossing interpretive site, portions of the Sublette Cutoff, Names Hill, the J. David Love site, the Wagon Wheel site, and the Sand Springs emigrant camp interpretive site. The Kid's Dig site is an educational, nonarcheological locale south of Fremont Lake used to create a simulated archeological site consisting of a stone circle, central slab-lined roasting pit, replicated artifact and lithic tool scatter, burned bone materials, and cache.

Category e, Experimental Use, includes cultural properties retained for controlled experimental studies, generally using experimental techniques that would result in at least partial alteration or destruction of the cultural resource. Pinedale Field Office (PFO) has established Experimental Use sites or locales in the past. More are possible in the future. In 1990, before the sesquicentennial of the first Catholic Mass

celebration, BLM was asked to provide parking space for the anticipated throngs of Catholics planning to attend the 150th anniversary at the DeSmet/Horse Creek Overlook. Archeological inventory identified a prehistoric lithic scatter and artifact distribution locale in the proposed parking area, Site 48SU1187. To facilitate the brush hog mowing of sagebrush for parking and to protect the prehistoric cultural materials located at the site, BLM created an experimental use for Site 48SU1187. Numbered nonartifact test materials were placed in a survey line at the mowing locale. Subsequent to mowing (and the 150th Catholic Mass), the site was reexamined to see whether any of the test materials were altered, damaged, moved, or collected. Reexamination of the study tract revealed that all nonartifacts were relocated and all were undamaged. Brush beating had not even moved the largest items (a cow bone, large core-sized cobble, and ceramic plate shard). The test concluded that given rather optimal conditions (a small working area of flat, cobble-armored surface with stable soils), brush beating would have no effect on surficial cultural materials.

Archeological resources allocated to category f, Discharged from Management, do not contain important scientific information beyond that obtained through standard recordation procedures and are not considered eligible for the NRHP because they lack further research potential. The majority of sites in the planning area fall in this category, including sites recommended as not eligible for inclusion on the NRHP that do not fall into one of the other use categories specified above.

Category a, b, and c sites require different evaluation and mitigation if adversely affected. Such mitigation might include preservation of in-situ buildings, structures, and historic properties; preservation of the setting when the setting contributes to the site's significance; archival records review; historical documentation; Historic American Buildings Survey (HABS)/Historic American Engineering Record (HAER) photogrammetric documentation; informant interview and reporting; historical site data recovery and artifact (building, structure) preservation; Native American consultation; and recommendation implementation.

3.3.4 Cultural Resource Concerns

Existing cultural resource concerns in the planning area involve prehistoric archeological sites, TCPs, rock art, trails, and other places or properties considered sensitive to Native Americans.

Prehistoric Archeological Sites

Prehistoric sites can have scientific, conservation, and traditional values and uses. The time period, location, integrity, and structure of a particular site influence the degree of its scientific value. For the same reasons that these sites have high scientific values, they can also have high conservation values. Conservation of prehistoric archeological sites also may result in better determination of areas of traditional cultural importance to affiliated tribes or TCPs. A TCP is defined as a place or property of traditional or religious importance that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the continuing cultural identity of the community (Parker and King 1998). TCPs that manifest as prehistoric archeological sites may include petroglyphs, select rock alignment sites, vision quest sites, archeological ancestral sites, gathering and procurement areas, human burial areas, or places that hold sacred or religious importance to the affiliated tribe or tribes. Sacred significance is placed on or is derived from ideological beliefs about the residing of human spirits in given locations. Executive Order 13007, *Indian Sacred Sites*, directs federal agencies to avoid adversely affecting the physical integrity of sacred sites to the extent practicable. As detailed below, BLM consults with all Native American tribes that have aboriginal territories within or cultural affiliation with the planning area as part of the Sections 106 and 110 processes to identify places of traditional cultural and sacred significance and determine potential impacts that could adversely affect areas within a proposed project area.

Several TCPs exist in the planning area. Native American consultation has resulted in a tribal desire to preserve the physical integrity of TCPs as much as possible. Native Americans stress the interrelatedness of many of these locales and emphasize that BLM should consider them more holistically, as cultural landscapes. Frequently, the disturbances resulting from energy development, especially those associated with wildcat exploration in previously undeveloped areas, create direct conflict with the tribal position of preserving unspoiled cultural landscapes associated with TCPs and other sites and locales considered sensitive, sacred, or of concern to modern day traditional Native American practitioners.

Within the planning area, archeological sites are subject to intense, unauthorized artifact collecting and are susceptible to incidental or accidental damage through actions such as off-highway vehicle (OHV) use or camping. Illegal artifact collecting and vandalism are all too common throughout the area and are particularly prevalent in the Trapper's Point area and the Jonah, South Anticline, Squaretop, and portions of the Ryegrass, LaBarge, and Deer Hills areas. Disturbance to rock alignment sites is severe at Site 48SU285, The Mesa, and the Ryegrass areas. Vandalism to rock art and historic inscription sites is severe throughout the planning area, wherever these sites are found. In cases in which heavy equipment and other construction activities affect archeological sites, existing procedures (inventory, evaluation, and avoidance/data recovery for significant sites) are usually adequate to mitigate adverse impacts. Nonetheless, unintentional damage occurs at an increasing rate as development projects affect buried sites in sensitive archeological areas. Casual secondary lithic procurement landscapes are treated as not significant or not eligible for listing on the NRHP because of their limited data potential and lack of intact, subsurface archeological deposits. Specific site concerns are as follows:

- **The Wardell Site.** A possible Avonlea bison bed/kill site that is listed on the NRHP is being severely affected by erosion and vandalism.

- **Boulder Lake District.** A draft cultural RMP was developed in 1991 for this property, which is being affected by shoreline action, unauthorized collection, and vandalism. This district is managed for the preservation of cultural and historical values, including periodic patrolling by law enforcement personnel to prevent the collection of artifacts and site vandalism. However, the plan has never been finalized, and a report of preliminary district investigations has not been prepared.

- **Jonah/Pinedale Anticline/LaBarge Oil and Gas Fields.** Compliance-related efforts in the Jonah/Pinedale Anticline/LaBarge oil and gas fields will continue to be performed under the National Programmatic Agreement (PA)/Wyoming Protocol. Site 48SU4000 is a large, complex archeological district consisting of about 25 archeological locales. Most locales are small rock shelters with features and associated artifact scatters. Because the area is currently part of a mineral lease that cannot be withdrawn, this site may be threatened by development sometime in the future. Management of cultural resources within the Jonah Field will occur in accordance with the PA for this field. Development of a specific cultural resource synthesis for the Jonah/Pinedale Anticline is called for in the records of decision (ROD) for these oil and gas fields.

- **Trappers Point ACEC.** Cultural resources have been severely damaged in this area. Decades of illegal artifact collecting were documented in the 1970s, and the cattle trampling in the Drift also has severely damaged cultural materials. Proactive management in this key area should be made a high priority.

Traditional Cultural Properties

Nonarcheological site types are distinguished from archeological site types because they are not necessarily associated with prehistoric or historic artifact assemblages and collections but may include vision quest areas, vegetal and mammal processing areas, ceremonial areas, and others. These sites are often referred to as TCPs and are typically identified by tribal representatives during the government-to-

government consultation process that is required of federal agencies. TCPs are one of several types of sites or locales that can be considered sacred, sensitive, or of importance to modern day Native Americans. TCPs can also be identified by representatives of other culture groups, such as historic culture groups associated with the Euroamerican migration to the western United States. A TCP must be determined to be eligible for inclusion in the NRHP based on its "association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (National Park Service [NPS] 1998). Several TCPs (Sites 48SU285, 48SU2019, and 48SU4100) have been identified and recorded within the planning area. Numerous sites (including additional archeological sites) of this type exist in the area. At least 10 prehistoric/Native American burial sites, mostly of single individuals, are known in the Upper Green River Basin region. Both scaffold burials and shallow pit burials have been reported in the area.

BLM is mandated to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by actions on federal lands. Places that may be of traditional cultural importance to Native American people include locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners have gone or go to perform ceremonial activities based on traditional cultural rules of practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes may be taken.

BLM consults with all Native American tribes with aboriginal territories within the planning area as part of the Sections 106 and 110 processes to determine the presence of nonarcheological site types, which are usually identified as TCPs, sensitive sites, sacred areas, and other areas and sites considered special or of concern to modern day Native American practitioners. BLM makes every effort to keep any information concerning these site types confidential to the extent possible. Typically, a tribe is not comfortable giving any information about these site types. The Federal Government will not be able to protect these sites if no location information exists. These site types can be further protected if a tribe is willing to provide traditional use information that can be used to determine the significance to tribal individuals. Integration of Native American concerns in overall project planning, especially in areas not developed for oil and gas, has been difficult in recent years. BLM will make an effort to balance the lease rights of energy developers with concerns of Native Americans to preserve traditional or sacred landscapes.

Prehistoric/Native American Burials

At least 10 prehistoric/Native American burial sites, mostly of single individuals, have been documented within the Upper Green River Basin region. Scaffold burials, rock niche burials, shallow pit burials, and burials from within aboriginal structures are reported for the area. Native Americans recognize burials and burial sites as sacred places that should not be disturbed. The most important concerns of Native Americans are the discovery, protection, and cultural affiliation of burial sites. BLM also recognizes the extreme importance placed on these locales by Native Americans and fully supports all efforts to protect them. Arguably, these locales represent the most significant, sensitive, and important cultural resources BLM manages in the planning area. In recognition of that fact, all location and other information is proprietary and cannot be released to the public. Many Native American groups, including groups that claim cultural affiliation within the planning area, maintain the following beliefs:

- The spirits of deceased ancestors remain associated with the burial for an undeterminable length of time and should not be disturbed. Disturbance interrupts the journey the spirit must make.
- Disturbance may also anger the spirit and cause harm to the living.
- Disturbance is disrespectful.

The Native American Graves Protection and Repatriation Act (NAGPRA) focuses on issues of protection and repatriation of Native American burials, associated funerary objects, and objects of cultural patrimony. Native American human burials and gravesites located on BLM-administered lands in the planning area are subject to management prescriptions identified by NAGPRA and its implementing regulations; however, these sites also require significant protection because of particular legal issues related to burials.

Avoidance of any disturbance to archeological sites containing graves on BLM-administered land and through BLM-permitted activity is BLM's firm policy. Any efforts expended in identifying such sites also maintain a "leave undisturbed—this information is strictly proprietary" policy. Archeological investigations for planning or research purposes on federal and tribal lands and other land-modifying activities on federal lands that inadvertently discover such items are required to comply with the procedures identified in NAGPRA and its implementing regulations.

Rock Art Sites

Prehistoric rock art sites include petroglyphs, which are inscriptions incised, carved, or pecked onto a rock surface (usually sandstone), and pictographs, which are images painted onto a rock surface. The planning area has both types of rock art. Rock art sites are extremely fragile and, unfortunately, highly susceptible to vandalism. To protect rock art sites, their locations are kept confidential. (Sites 48SU1863 and 48SU4112 are two such sites.) Because disturbance near rock art sites is also of concern to Native Americans, activities near such sites usually trigger Native American consultation.

An exception to the nondisclosure provision attached to rock art sites may be at Site 48SU354, the Calpet Rock shelter. Because the shelter has been excavated, and all rock art panels have been recorded, BLM is considering making the location of this site more open to the public.

Surface disturbing activities in the immediate vicinity of rock art sites can be restricted, and such activities near rock art sites constitute a reason to consult with Native Americans concerning the appropriateness of the proposed undertaking. OHV travel (including geophysical exploration activities) and the use of fire retardant chemicals containing dyes may be restricted in the vicinity of rock art sites. Representatives from the Shoshone and Ute tribes have stated during onsite meetings with BLM personnel that all Native American-produced rock art sites in the Green River Basin are significant to contemporary indigenous groups. All other rock art sites (specifically historic, Euroamerican rock art) are managed on a case-by-case basis according to resource values.

Historic Trails

Within the planning area, congressionally designated historic trails include portions of the Sublette Cutoff and Lander Road/Trail, both components of the Oregon/California National Historic Trails system. Protection of the National Historic Trails in the planning area involves coordination with the NPS, which performs in an oversight capacity for these trails under the National Trails System Act. Management of these trails is augmented by the *Comprehensive Management and Use Plan for the California, Pony Express, Oregon, and Mormon Pioneer National Historic Trails* prepared by the NPS in 1999. Although many protection measures are in place, development activities (e.g., roads, pipelines, and power lines) can cross trails in areas where the trail has lost its NRHP characteristics and would no longer be considered a contributing segment to the trail because previous disturbance has occurred. Visual management of the Lander Trail landscape from US Highway 191 to the Green River Crossing is addressed in the ROD for the Pinedale Anticline Oil and Gas Exploration and Development Project EIS. This EIS states that well pads, access roads, and pipelines can be located on federal lands and minerals in a manner that minimizes their visibility from the trail to the extent practicable and will be subject to viewshed analysis, with mitigation developed as a result of this analysis. In addition, the PFO staff is conducting a condition assessment for the Lander Trail from Buckskin Crossing to the Sand Springs Emigrant Camp, and a

condition assessment of the Sands Springs to Muddy Creek segment is currently being prepared by an outside consultant.

Past historic trails management in the planning area was based on a one-quarter-mile buffer/controlled surface use (CSU) stipulation using the center of the trail trace as the centerline. Surface disturbing activity was allowed if it was proposed beyond the one-quarter-mile buffer (as it grew to be called). Little to no attention was devoted to managing the viewshed or the overall setting of the trail. The result of this management was that a series of disturbances were concentrated at the edge of the one-quarter-mile buffer. Because the trail system was essentially a wagon road that selected easier grades, natural passes, and flatter terrain rather than hills or steep or broken country, much of the trail system in western Wyoming (and in the planning area) possesses large, expansive viewsheds over flatter terrain. Modern intrusions such as well locations with their high-profile storage tanks, unnaturally shaped dehydration facilities, and linear surface disturbances for roads and pipelines contrast greatly with the natural setting. Although the one-quarter-mile buffer was successful in preserving the footprint of the trail (its trace), the buffer failed to maintain the integrity of setting and integrity of place of the historic trail in its 19th-century context.

Historic Sites

Historic sites, which are defined as sites 50 years or older, include fur trade/rendezvous-related sites; historic trails and related campsites, river crossings, graves, and inscription sites; homestead remains, cabins, barns, other outbuildings and ranching materials, and stock maintenance camps; early oil- and gas-related sites and artifacts; mines; timber-industry-related sites; and artifacts, roads, and trails. Many historic sites are highly visible, such as cabins and historic inscriptions. As highly visible sites, they are subject to vandalism, but several methods can be used to protect these sites. In addition, the architectural elements for some of these sites (walls, floors, etc.) are also subject to weathering and deterioration. When time and money allow, efforts are made to stabilize such sites. Efforts are made to balance development and preservation and to determine a means of protecting them from human and natural harm, except in the Scab Creek and Lake Mountain Wilderness Study Areas (WSA). The known historic cabins in the Scab Creek WSA are decaying naturally. The cabins need to be evaluated for NRHP eligibility and can be further managed by BLM. BLM's Interim Management Policy (IMP) in WSAs indicates that such resources can be further rehabilitated, stabilized, or restored as long as BLM's nonimpairment criteria are met. Trash scatters, in general, are not considered significant or eligible for inclusion on the NRHP because they are not likely to produce information that would significantly further understanding of the region's history.

3.4 FORESTRY

The planning area contains approximately 31,590 acres of forestland and an additional 15,280 acres of woodland for total forest acreage of 46,870. The forestlands comprise commercial conifer tree species that are in economic demand for milling into salable lumber and that could be managed for sustained yield. The commercial conifer species include lodgepole pine, Douglas fir, Engelmann spruce, and subalpine fir. Forestlands also include nonstocked areas that have supported or are capable of supporting one or more of the commercial conifer tree species. The primary woodland species are aspen and limber pine.

Table 3-7 shows acreage and volume distributions by species. The acreages and volume figures in this table were derived from intensive forest inventory data collected from 1980 through 1983 using the USFS Stage II forest inventory method. The Stage II inventory did not cover low elevation transitional limber pine and juniper woodlands. No accurate figures are available for these transitional woodlands, and they are excluded from this analysis and discussion.

Table 3-7. Acreage and Volume Distributions by Species for Forests within the Planning Area

Timber Type and Size Class	Acres	Net Cubic Foot Volume[1] (per acre)	Total Net[3] Cubic Foot Volume	Total Volume (board feet)
Commercial conifer				
Lodgepole pine				
Saw timber stands	7,187	2,305	16,566,035	74,547,158
Pole timber stands	2,711	1,788	4,847,268	21,812,706
Seedling/sapling stands	438	578	253,164	1,139,238
Douglas-fir				
Saw timber stands	11,015	1,946	21,435,190	96,458,355
Pole timber stands	1,620	1,479	2,395,980	10,781,910
Spruce-fir				
Saw timber stands	6,974	2,650	18,481,100	83,164,950
Pole timber stands	655	1,319	863,945	3,887,752
Seedling/sapling stands	158	242	38,236	172,062
Nonstocked stands	832	260	216,320	933,440
Woodland				
Aspen				
All classes	15,198	955	14,514,090	15,729,930
Whitebark/Limber pine				
All classes	82	NA[2]	NA[2]	NA[2]
Total	**46,870**	**1,699**	**79,611,328**	**308,667,501**

[1] Both live and dead volume (approximately 10% is sound dead material).
[2] Data not available.
[3] Original data indicate 4 board feet per cubic foot. Most recent USFS (2006) data show 5 board feet per cubic foot.

The average annual historical harvest of forest products within the planning area is as follows:

- Years 1995–1999
  – Timber sales: 495 thousand board feet (MBF) or 990 hundred cubic feet (CCF), covering 105 acres

- Years 1998–2006
  - Christmas trees: 312
  - Wildings: 4
  - Firewood: 20 CCF
  - Posts and poles: 6 CCF
  - Personal Use saw timber: 400 board feet (BF) or 80 cubic feet (CF).

Much of the forest acreage is concentrated along the northern, eastern, and western boundaries of the planning area and occurs on north and east slopes as narrow, stringer-like stands that originate from larger blocks of timber at higher elevation on USFS lands. For analysis purposes, the area has been divided into four individual management units:

1. The Deadline-Pinegrove Unit, which lies between South Piney Creek and LaBarge Creek, includes the Graphite elk winter range, Riley Ridge elk winter range, and Rock Creek ACEC. The unit contains an estimated 13,448 acres of forestland and 3,510 woodland acres, of which 1,322 acres of forestland and 180 woodland acres are in the Rock Creek drainage, 2,117 acres of forestland and 840 woodland acres are in the Graphite winter range, and 1,028 acres of forestland and 153 woodland acres are in the Riley Ridge winter range.
2. The North Piney Unit, which lies between the Maki Creek drainage and South Piney Creek, includes two elk feed grounds: Finnegan and North Piney. The unit contains approximately 5,158 acres of forestland and 4,451 woodland acres, of which 708 acres of forestland and 354 woodland acres are in the feed grounds.
3. The Miller Mountain Unit, which lies between LaBarge Creek and Fontenelle Creek, includes the Fort Hill-Fontenelle elk winter range. The unit contains 8,191 forested acres (4,241 acres of forestland and 3,950 acres of woodland), of which 277 acres of forestland and 145 woodland acres are in the elk winter range. In addition to the forest resource, the Miller Mountain Unit provides yearlong habitat for 200 to 400 elk.
4. The Eastside-Hoback Unit consists of scattered parcels and blocks of forested land along the eastern and northern boundaries of the planning area. The unit contains the Scab Creek area and the Franz elk feed ground. The unit is composed of 8,743 acres of forestland and 3,369 woodland acres. The Franz feeding ground has roughly 127 acres of trees (75 acres of forestland and 52 acres of woodland). The Scab Creek area has 184 acres of forestland and 271 woodland acres.

Conditions of the forestlands vary from young, healthy, relatively insect- and disease-free stands to those that are quite old with high levels of insect and disease activity and high mortality rates. Most forestland stands in the planning area are starting to exhibit a reduction in vigor and growth, and increases in disease and insect susceptibility are resulting in mortality. Inventory data indicate that current mortality rates vary from zero volume loss in young seedling and sapling stands to 18.4 CF per acre per year in the spruce-fir saw timber stands. The average mortality rate for all stands is approximately 7.7 CF per acre per year or a total yearly loss level of nearly 1.64 million board feet (MMBF). About 98% (1.61 MMBF) of the mortality is commercial conifers. Primary insects or diseases include bark beetles, dwarf mistletoe, root diseases, and several varieties of rusts.

Analyses of the Stage II inventory data in the 2005 Wyoming BLM Forest and Woodland Management Action Plan using the Fire Regime and Condition Class guidelines show that 7,900 acres of the forested lands are in Condition Class 1, 20,500 acres are in Condition Class 2, and 3,200 acres are in Condition Class 3. Condition Class 1 considers that the vegetation and fuel conditions are within the natural range of variability that occurred under the natural fire regime with all the ecological components intact. Condition Classes 2 and 3 are uncharacteristic moderate to high departures from the reference condition, and components of the natural vegetation may be or are at risk for loss from the ecosystem in the event of a

disturbance.

Forestlands are located in the following management areas or zones with various management constraints:

- The Scab Creek WSA is forested on most of its 7,710 acres. Active forest management practices are prohibited in WSAs to avoid changing the character of the area until a decision is made on its status as a wilderness area.
- The Lake Mountain WSA is forested on most of its 13,490 acres, and active forest management practices are prohibited here as well.
- The Rock Creek drainage and ACEC contains 1,899 forested acres in both forestland and woodland types, of which 397 acres are outside the actual drainage. The significance of the Rock Creek area is that it harbors a pure strain of Colorado River cutthroat trout, a state-listed Sensitive Species. The Rock Creek ACEC falls within the Lake Mountain WSA.
- The Scab Creek campground is a semideveloped campground constructed adjacent to the Scab Creek WSA. The identified campground area contains 30 forested acres.
- The Beaver Creek ACEC contains 1,655 forested acres and, like Rock Creek, supports a pure strain of Colorado River cutthroat trout.
- The riparian buffer areas include those forested acres within a specified distance of existing riparian zones. The buffers would be used to maintain shade over live water sources and as sediment filters from upslope sources.
- Three elk winter ranges provide elk with crucial winter habitat. The Graphite winter range includes portions of Deadline Ridge, Lake Mountain, and all of the Rock Creek drainage. Excluding the forested acreage in the Rock Creek drainage, the Graphite winter range contains 2,957 forested acres (forestland and woodland). The Riley Ridge winter range occupies portions of Riley and Reed ridges and contains 1,181 forested acres. The 422 forested acres within Fort Hill provide the primary source of thermal cover in the Fort Hill-Fontenelle winter range.
- In addition to the natural elk winter ranges, several elk feed grounds exist within the planning area, of which the Finnegan, North Piney, and Franz could affect forest management. Collectively, these three feed grounds contain 783 acres of forestland and 406 acres of woodland.

3.5 LANDS AND REALTY

Most of the planning area is BLM-administered public land and federal mineral estate (Table 1-1, p. 1-1). The public lands are used for a wide variety of purposes, and conflict among competing uses is common.

3.5.1 Surface and Mineral Ownership

Landownership and jurisdiction is summarized in Table 1-1 (p. 1-1) and shown on Map 1-2. The planning area includes only those lands within Sublette and Lincoln counties that are administered by the PFO (approximately 922,880 surface acres and 1,199,280 acres of federal mineral estate). Although BLM administers the leasing of the mineral estate underlying USFS and Bureau of Reclamation (BOR) withdrawn lands, mineral management decisions on these lands are made by the surface management agency. On many of the private lands, the mineral estate (either all of the minerals or portions of the minerals) is reserved to the U.S. Government. In these cases, the mineral estate is administered by BLM, although the private landowners administer the surface estate.

3.5.2 Methods of Public Land Management

Several aspects of public land management must be considered in the RMP process, including land tenure adjustments (e.g., disposals, acquisitions, and withdrawals), rights-of-way (ROW), and permits and leases. Issues relating to access are discussed under Transportation, Access, and Travel Management (Section 3.12).

Land Tenure Adjustment

There are several categories of land tenure adjustment with the purpose of disposal, acquisition, or withdrawal.

Disposal

Public lands have potential for disposal when they are isolated and/or difficult to manage. Disposal actions are usually in response to public request, such as community expansion. Disposals result in a title transfer, wherein the lands leave the public domain. All disposal actions are coordinated with adjoining landowners, local governments, and current land users.

Public sales are managed under the disposal criteria set forth in Section 203 of the Federal Land Policy and Management Act (FLPMA). Public lands determined suitable for sale are offered on the initiative of the BLM or through a nomination/request for sale from the public. The lands are not sold at less than fair market value. Lands suitable for sale must be identified in the RMP. Any lands to be disposed of by sale that are not identified in the current RMP require a plan amendment. Disposal of the mineral estate must conform to Section 209 of FLPMA (for sales) and 206 of FLPMA (for exchanges). This will require a mineral potential report; the mineral estate may be retained depending on the mineral values.

Land exchanges are initiated in direct response to public demand or by the BLM to improve management of the public lands, and the lands need to be formally determined suitable for exchange. Nonfederal lands are considered for acquisition through exchange of suitable public land, on a case-by-case basis, where the exchange is in the public interest and where acquisition of the nonfederal lands will contain higher resource values than the public lands being exchanged. In all land exchanges, keeping the surface and mineral estate intact on both the disposed and acquired lands would benefit the future owners and their use of the land.

Acquisition

Acquisition of lands can be pursued to facilitate various resource management objectives. Acquisitions, including easements, can be completed through exchange, land and water conservation funds (LWCF) purchases, donations, or receipts from the Federal Land Transaction Facilitations Act sales or exchanges. Lands considered for acquisition would be those lands that meet specific land management goals identified in the RMP.

Withdrawals

Withdrawals are used to preserve sensitive environmental values, protect major federal investments in facilities, support national security, and provide for public health and safety. They segregate a portion of public lands and suspend certain operations of the public land laws, such as mining claims. Currently, 147,320 acres are under a coal withdrawal, and 1,190 acres are under a phosphate withdrawal, a total of approximately 148,510 acres (Map 3-3). The purpose for which these withdrawals were established is no longer pertinent because these minerals, other than oil shale, are now acquired through a leasing system and are no longer available for location. In addition, commercial quantities of these minerals are not present in the planning area. Certain SDWs are also withdrawn.

It is now federal policy to restrict all withdrawals to the minimum time required to serve the public interest, maximize the use of withdrawn lands consistent with their primary purpose, and eliminate all withdrawals that are no longer needed.

Rights-of-Way

Corridors established to contain ROWs are preferred routes for transportation and transmission facilities. ROWs in the planning area are for pipelines, roads, and electrical and telephone lines. To the extent possible, linear ROWs, such as roads and pipelines, are routed where impacts would be least disturbing to environmental resources, taking into account the point of origin, point of destination, and purpose and need of the project. Although established corridors exist, this does not preclude the location of transportation and transmission facilities in other areas if environmental analysis indicates that the facilities are compatible with other resource values and objectives. Further identification of corridors may not necessarily mandate that transportation and transmission facilities be located within these areas if they are not compatible with other resource uses, values, and objectives in and near the corridors or if the corridors are saturated. ROWs are issued with surface reclamation stipulations and other mitigating measures. Restrictions and mitigating measures may be modified on a case-by-case basis, depending on impacts on resources. Areas closed to mineral leasing, having a no surface occupancy (NSO) restriction, or otherwise identified as unsuitable for surface disturbance or occupancy are generally avoidance or exclusion areas for ROWs.

The PFO currently receives an average of 300 ROW applications per year. The majority of these applications are related to oil and gas activity for pipelines and roads.

Wind energy developments are permitted through ROWs rather than through the minerals program. The potential in the planning area for wind energy development is low. The Hogsback is the only area that has been classified as having potential for wind energy development. The Hogsback area is classified as a low potential area for wind energy in the document *Assessing the Potential for Renewable Energy on Public Lands.* However, there is no existing infrastructure (i.e., power lines) to transport the electricity out of potential wind energy fields. For more information, please refer to the Wind Energy Final Programmatic EIS (http://windeis.anl.gov/eis/index.cfm).

Leases and Permits

Section 302 of FLPMA states that public lands may be authorized to state and local governments and

private citizens to use, occupy, or develop. Uses that may be authorized include agricultural development, residential (under certain conditions), commercial, advertising, and National Guard. Permits are usually short-term authorizations not to exceed 3 years. Leases are long-term authorizations that usually require a significant economic investment in the land. Temporary use permits are considered for areas to be used only during construction or for other short-term needs. There are currently nine leases within the field office. All of these leases are for production of hay.

Recreation & Public Purposes Act

The Act authorizes the sale or lease of public lands for recreational or public purposes to state and local governments and to qualified nonprofit organizations. Examples of typical uses under the Act are historic monument sites, campgrounds, schools, fire houses, law enforcement facilities, municipal facilities, landfills, hospitals, parks, and fairgrounds.

3.6 LIVESTOCK GRAZING

3.6.1 History and Setting

In the 1890s, cattlemen began to winter their livestock in the protected valleys in and near the planning area. By the 1900s, homesteaders had taken up ranching and farming along the major streams and rivers. Because of the high elevation and low precipitation, the climate was not suitable for growing crops requiring longer growing seasons. Therefore, hay was the primary crop produced using irrigation water diverted from rivers and streams. The rangelands surrounding the irrigated pastures remained part of the public domain and were used as livestock pasture through most of the spring, summer, and fall. In the winter, cattle and sheep were trailed to ranchers' private land where they were fed hay produced the previous summer. Livestock returned to the publicly owned rangelands in the spring after lambing or calving on the ranch. This cycle of wintering livestock on private lands and grazing public land allotments in the warmer months continues to be the most common pattern of livestock grazing use.

Initially, the public rangelands were grazed in common on a first-come, first-serve basis. With passage of the Taylor Grazing Act in 1934, the Federal Government regulated the use of public lands for grazing, and ranchers were given an authorization for a certain number of livestock and season of use. This grazing use was limited to a specified geographical area or grazing allotment.

Following the initial authorizations, the U.S. Government (U.S. Grazing Service from 1934 to 1946; BLM from 1946 to present) began to fence smaller allotments and complete surveys to determine the total amount of forage within each allotment. During this period (1934–1960), many grazing permits were reduced, and the majority of the allotment boundaries were fenced. Numerous water projects were also constructed during this time period to improve livestock distribution within these allotments. In 1976, FLPMA declared "that the public lands be managed in a manner…that will provide food and habitat for fish and wildlife and domestic animals…."

There has been an increasing trend in recent years for some ranchers to sell off portions of their deeded lands to be able to maintain the remainder as a viable unit and in the historic family ownership and traditions. Frequently, the sale of a portion of a base ranch to stay in business or the sale of an entire ranch to a party that is not interested in ranching results in the subdivision of all or a portion of the original acreages. The result is a loss of viability of a ranching unit and the cultural way of life associated with it. Open space, critical wildlife escape cover, wintering habitat, wildlife corridors, and public access to these lands are also often lost. These lands are important to wildlife, tourism, recreation, and rural communities. Furthermore, use of BLM lands in the summer helps provide for increased levels of forage on deeded lands that are used by livestock and wildlife in the fall and winter.

3.6.2 Livestock Grazing Administration

Cattle and horses graze the BLM-administered lands within the planning area. Of the 219 allotments, 197 are cattle operations and 16 have only horses or both horses and cattle. Cattle are allotted 97% of the available animal unit months (AUM). Appendix 20 provides the number and name of each allotment, permitted AUMs, suspended AUMs, class of livestock (cattle and/or horses), and the period of use. The total permitted AUMs for the planning area are 107,536 AUMs. The actual use during the past 3 years has been approximately 70% of the permitted AUMs, owing in part to drought conditions and the inability of some operators to replenish previously reduced livestock herds. Additional information concerning AUMs by allotment is included in Appendix 21, Acres and AUMs by Land Status by Allotment. Grazing allotments are shown on Map 3-4.

Season of Use

The majority of the allotments in the planning area are considered lower-elevation allotments, and livestock turnout in these allotments typically occurs from May 1 to June 1. After 4 to 6 weeks, the livestock on these allotments are moved to higher-elevation pastures. The higher-elevation pastures could be entirely private land, USFS-administered allotments, or other BLM-administered allotments. There are several BLM-administered allotments at higher elevations where grazing does not begin until late June or early July. Typically, the season of use for these allotments is 2 to 3 months. Two allotments (each containing approximately 100,000 acres) have a 5-month season of use. There are also a few allotments that are grazed in the fall.

Because of variations in weather and range readiness, the turn-on dates for the USFS allotments are sometimes delayed. This delay sometimes causes an extended period of use on BLM-administered allotments. The USFS and BLM cooperate in determining range readiness for the allotments and coordinate movement of livestock from BLM allotments to USFS allotments.

In some years, allotments are not ready for livestock grazing on the traditional turn-on dates, particularly in allotments with early turnouts (May 1 to May 15). In these cases, adjustments can be made with permittees to defer grazing until the range is ready. Many allotments are grazed annually in May and June, the peak growth period for most forage plants. Repeated grazing during this period can affect long-term forage vigor and range condition.

Seventy-three allotments are small and scattered federal acreage, fenced in with larger tracts of private and state land. Annual grazing authorizations for these allotments contain a stipulation that states, "seasons of use and livestock numbers are not restricted as long as over-use of forage and range deterioration do not occur."

In addition to the 219 grazing allotments, there are 21,000 acres of unallocated parcels. These parcels range in size from less than 5 acres to approximately 1,200 acres. Many of the parcels are small corners of public lands fenced into private hay meadows.

Livestock in the planning area are trailed across public land and highway ROWs to reach allotments managed by BLM and USFS. Trailing activities are authorized on a case-by-case basis. There are two SDWs on public land: the Cora SDW and the Silver Creek SDW. The Cora SDW extends from the Cora Y west of Pinedale to the USFS lands on the Upper Green River area north of Pinedale. The Cora SDW is used during a 2-week period in June when about 28 permittees drive roughly 7,000 cattle to summer pasture and during a 1-month period in the fall when the cattle are driven back to the home ranches. Essential components of this SDW are Trapper's Point and the holding pasture at the Cora Y. The Silver Creek SDW is within the Cottonwood common allotment and provides a trail from the public lands to the USFS allotments to the east.

Management Categories and Allotment Management Plans

Three management categories for allotments are used to define the level of management needed to properly administer these grazing lands. The allotments are categorized as Custodial (C) allotments, Maintain (M) allotments, or Improve (I) allotments. Twenty-six allotments, which encompass 20,878 acres of public land, are in the C category; 147 allotments (475,802 acres of public land) are in the M category; and 40 allotments (556,966 acres of public land) are in the I category (U.S. Department of the Interior [USDI], BLM 1988). Most of the C category allotments are small parcels of public land intermingled with larger tracts of private and/or state land. Because of the small amount of public land, the level of administrative effort on these lands is low. The M category allotments are either in good condition, or the allotment does not contain many sensitive resources. Although some investment in time or money would be justified in these allotments, they are not as high a priority as I category allotments. The I category allotments either exhibit unsatisfactory vegetation conditions or contain significant

sensitive resources that justify investments of time and money. These allotments have the highest priority for monitoring and range improvement development. Further information pertaining to some allotments is contained in allotment management plans (AMP), which have been developed to achieve livestock grazing objectives on some allotments. An AMP describes the grazing practices to be used, such as livestock rotation through pastures within the allotment, pasture deferment schedules, or pasture rest schedules. An AMP also outlines the season of use, development and use of range improvements, salting practices, and management objectives such as vegetation condition goals or livestock performance targets. Roughly 40% of the planning area is under some kind of grazing management plan, and currently there are 13 completed AMPs. Some of these AMPs were prepared in the mid-1970s and may need to be evaluated and revised. Since 1988, two AMPs have been created and implemented, and three AMPs have been revised.

3.6.3 Range Improvement Projects

Range improvements in the planning area include water developments (wells, springs, reservoirs, and pipelines), livestock management facilities (fences, cattle guards, and corrals), and vegetation manipulation projects (prescribed burns, herbicide sprays, and mechanical treatments). Normally the livestock operators are responsible for construction and maintenance, and BLM provides the materials and design. Range improvements are designed and constructed to minimize adverse environmental impacts and maximize grazing function and cost effectiveness (USDI, BLM 1988). Emphasis on construction or implementation of range improvements is normally placed on I category allotments. Further information on operating procedures and design of range improvements and vegetation manipulations can be found in Appendix 15. BLM works closely with conservation districts and local Wyoming grazing districts to facilitate management of rangelands, monitoring of rangeland health, and planning for projects to enhance rangeland condition on public and private lands.

Water Developments

Water projects are the most numerous type of range improvements and are intended to improve livestock distribution without fragmenting habitat with fences. Most existing water developments were constructed in the 1960s and 1970s. Currently, there are 492 water developments: 45 spring developments, 113 wells, 308 reservoirs, and 26 other types of water developments. Forty-three new water developments have been constructed since the 1988 RMP. The condition of many water improvements is currently unknown.

Spring developments are designed to pipe water away from a spring to water tanks or troughs, thereby protecting the spring from animal trampling and providing a water source where many animals can drink clean water at the same time. Many springs are also fenced after the water is piped to a new location, further protecting the spring's production and water quality. Typically, wells are drilled in areas where other water sources could not be feasibly developed. Wells may have a windmill or an electric pump if electricity is available, to bring the water to the surface. Reservoirs are constructed by using the native soils to form a dam or pit across drainages. Reservoirs are designed to catch seasonal or storm runoff and provide livestock with drinking water after the ephemeral streams have dried up.

Spring developments and wells provide the most reliable and highest quality water and can allow water to be piped for several hundred feet, supplying numerous water tanks with drinking water. This water can be piped to areas not attractive to cattle, such as mesas and ridges, further improving livestock distribution. Increased livestock distribution facilitated by water developments can increase the available forage in the allotments. This could increase the actual use of the allotment. Reservoirs are often used in areas in which springs and wells are impractical. The water source for most reservoirs is seasonal and storm runoff. Reservoirs may be low or dry during low precipitation years. Because reservoirs are in draws, they attract cattle to the lower elevation areas of the pasture, and higher slopes and mesas do not receive equal amounts of grazing. However, reservoirs require little maintenance and can provide additional benefits such as waterfowl habitat and wildlife drinking water.

Fences

The majority of the allotment boundaries within the planning area have been fenced, with pasture division fences within some allotments. The major highways in this area have also been fenced. New fences are designed to reduce impacts on big game animals and comply with BLM Manual H-1741-1. Since the 1988 RMP, 17 new fences have been constructed, including pasture division fences designed to improve livestock management and distribution and reconstruction of existing allotment boundary fences.

Vegetation Treatments

The objective of most vegetation treatments is to break up shrub age class and increase herbaceous forage production. Vegetation treatments are commonly designed to mimic natural wildland fires, which have been occurring on these rangelands for thousands of years. A common vegetation treatment is prescribed burning, which kills woody vegetation such as big sagebrush. Prescribed fires usually burn at lower temperatures than wildfires, enabling a much quicker recovery time for the surviving, fire-tolerant plant species. The ground surface temperature may damage, but usually does not destroy, the root crown of fire-tolerant perennial grasses. This enables herbaceous forage to flourish after the competition for light, nutrients, and water is removed.

Sagebrush treatments completed in the 1960s and 1970s involved herbicide spraying, which successfully removed sagebrush from several thousand acres. Following natural fire, sagebrush naturally reestablishes itself within its habitat within 5 to 40 years. In the absence of natural fire cycles, vegetation treatments are needed to maintain the proper balance of shrub and herbaceous species on the rangelands. This benefits livestock that graze the forage but also benefits wildlife owing to increased habitat diversity, forage production and vigor, stream and spring flows, soil stability, and nutrient cycling. The use of vegetation treatments in sensitive sage-grouse habitat continues to be controversial, and any vegetation treatments in those areas would need to be designed to maintain or improve the specific components of the sagebrush plant communities that may be most limiting to the local sage-grouse populations.

The purpose of vegetation treatments since 1988 has been to create diversity in even-aged stands of sagebrush and improve big game winter range habitat, as well as increase the quantity and quality of forage for livestock. Since 1988, 8,700 acres have been prescribed burned, 3,660 acres have had herbicide applied for brush control, and 4,440 acres have been treated mechanically (Table 3-8).

Table 3-8. Vegetation Manipulations Since 1988

Name	Acres
Burns	
40 Rod	400
Boulder Lake	1,000
Burdick Creek	1,000
Brodie Draw	2,000
Coal Creek	1,000
Cottonwood	1,000
Cretaceous	400
Spade	500
Deer Hills	400
Gentle Annie	1,000
Herbicide	
Beecher	160
Bench Corral	700
Boulder Lake	1,000

Name	Acres
McNinch Deer Hills	600
O'Neil	200
Mechanical Treatments	
Tip top mowing brush beating	2,400
Chaining	1,700
Pitting and ripping	300

3.6.4 Rangeland Condition

The last ecological condition inventory in the planning area occurred in the mid-1980s. Results indicated that 5,609 acres were at the potential natural community; 479,170 acres were in late seral stage; 420,571 acres were in midseral; 16,751 acres were in early seral stage; and 9,529 acres were undetermined. In many cases, vegetation communities are stable and may require a disturbance event, such as fire or mechanical treatment, to change the current seral status or state.

About 65% of the planning area has been evaluated for compliance with the Wyoming Standards for Rangeland Health (USDI, BLM 1997a). These assessments indicated that 122 allotments are meeting the standards, 20 allotments (283,508 acres) are not meeting 1 or more standards as a result of grazing, and 72 allotments have not been assessed. Appendix 20 identifies those allotments that have been evaluated and the results of those evaluations. Monitoring of rangelands is conducted primarily by the field office Rangeland Management staff, which generally documents use levels, conditions, and trends in rangeland attributes in coordination with current processes such as the Wyoming Standards for Rangeland Health and grazing permit renewals.

In recent years, additional focus has been placed on riparian habitat. Vegetation within riparian areas is influenced by the close proximity of the water table to the surface and tends to be more abundant and palatable to wildlife and livestock for longer periods of time than the surrounding upland vegetation. As a result, riparian areas are often the focus of grazing impacts. Willows and cottonwood found in these areas also provide shade. Proper functioning condition (PFC) assessments were conducted on riparian areas within each allotment. PFC is the minimum acceptable level of the ecological condition for flowing (lotic) and still (lentic) surface waters. It is a qualitative method for assessing the physical functioning of riparian and wetland areas and is a term that defines on-the-ground condition. The PFC assessment considers hydrology, vegetation, soil, and landform attributes to reduce erosion and improve water quality during high flows. PFC is a state of resiliency that would allow a riparian-wetland system to remain stable during a 25- to 30-year flow event, sustaining that system's ability to produce values related to both physical and biological attributes such as fish and wildlife habitat, forage, and erosion control.

Riparian areas that are not in PFC are classified as either functioning at risk or nonfunctional. A riparian area functioning at risk may perform some degree of riparian function but still has a high probability of degradation associated with high-flow events. Nonfunctional riparian areas clearly lack the attributes and processes necessary to maintain stability. All known streams on public land within the planning area have been assessed. This assessment indicates that 60% of stream miles are in PFC, 39% are functioning but at risk of degradation, and 1% are not functioning. The results of the PFC assessments by allotment are identified in Table 3-9. On those reaches identified as Functioning at Risk with a nonapparent trend and lower, quantitative data are needed to determine the present-day condition of these areas, as well as the factors affecting the particular stream reaches.

Table 3-9. Riparian Proper Functioning Condition Summary (grouped by allotment)

Date	Allotment	Rating (miles)					Total (miles)
		PFC[1]	FAR[2]			NF[4]	
			Up[3]	n/a[3]	Down[3]		
1998/1999	Alkali Draw Individual	10.00		2.00			12.00
1999	Ball Individual	1.00					1.00
1996	Bench Corral Individual		5.00	5.50			10.50
1995/1998	Beecher Creek Individual	2.00		0.50	1.25		3.75
1997	Boulder Lake Common	1.75					1.75
1995/1996/ 1998	Camp Creek Individual	4.33					4.33
1994/1998	Cora SDW	1.75		0.50			2.25
1998	Cottonwood Common	1.25				1.25	2.50
1998	Cranor Building Individual				0.50		0.50
1996	East Fork Common	7.00					7.00
1995	Fish Creek Individual			1.00			1.00
1995	Flying W Fish Creek	1.50					1.50
1994/1997	Fox-Yose Common	0.25		0.50			0.75
1997	Fremont Butte Common			2.50			2.50
1997	Gilchrist DLE Individual			0.25			0.25
1997	Guio Sections Individual		1.25	0.50	0.50	0.25	2.50
1996	Hay Gulch Individual			0.25			0.25
1998	Heifer Pasture Individual			0.50			0.50
1997	Hoback Rim Individual	1.50					1.50
1998	Horse Creek Road Individual			0.25			0.25
1996	Hot Springs Pasture Individual	0.25					0.25
1998	Jory Individual	0.75					0.75
1994	LaBarge Individual	0.75					0.75
1996	Lander Cutoff Individual	3.50					3.50
1996	Lauzer Marsh Creek Individual	0.50					0.50
1996/1997	Lower Bench Corral Common	2.50		0.50			3.00
1996	Maki Creek Individual	1.00					1.00
1996	Muddy Corral Individual	1.50					1.50
1997/1998	Muleshoe Individual	1.00		2.25			3.25
1994/1996/ 1997/1998/ 1999	North LaBarge Common	20.55	3.50	9.25	2.25		35.55
1998	Norris North Piney Individual	0.75					0.75
1998	North Hoback Rim Individual	2.00					2.00
1998	Pine Creek Individual	0.25					0.25
1996	Piney Individual	0.75					0.75
1995/1996	Pole Creek Individual	3.75					3.75
1997	Rathburn Individual	3.25					3.25
1995/1997	Red Canyon Common	10.30		1.95			12.25
1997	Round Valley Ryegrass Individual	2.25					2.25
1997	Scab Creek Individual	4.25		0.33			4.58
1996	School Section Individual			0.75			0.75

Date	Allotment	Rating (miles)					Total (miles)
		PFC[1]	FAR[2]			NF[4]	
			Up[3]	n/a[3]	Down[3]		
1998	Section 18 Individual	1.00					1.00
1997	Soaphole Common	2.00		3.00			5.00
1994/1995/ 1997/1999	South LaBarge	25.51	5.79	22.25	2.00		55.55
1999	South Piney Individual	0.25		0.75			1.00
1998	South Piney Ranch Individual	1.50					1.50
1998	Springman Creek Individual	1.50					1.50
1997	Upper Bench Corral Common			0.50			0.50
1995/1996	Upper Billies Individual	6.50		3.00	2.00		11.50
1997	Upper Green River	10.25					10.25
1997	Upper Horse Creek Individual	0.25					0.25
1996/1998	Upper Muddy Individual	2.20		3.70			5.90
1994/1997/ 1998	Upper North LaBarge	2.75	3.00		2.50		8.25
1997	Upper Post Individual			0.50			0.50
1999	Warren Bridge Individual	0.50					0.50
1997/1998	West Individual	1.00		1.00			2.00
1998	West of Ranch Individual	0.50					0.50
TOTAL (miles)		**147.89**	**18.54**	**63.98**	**11.00**	**3.50**	**244.91**
Percent of total		60%	8%	26.1%	4.5%	1.4%	100%

[1] PFC = proper functioning condition.
[2] FAR = functioning at risk.
[3] Up, n/a, and down refer to apparent trend for sites in functioning at risk condition. n/a means no trend apparent.
[4] NF = nonfunctioning.

3.7 MINERALS

This section describes the geologic environment and related mineral development within the planning area. Components discussed in detail include the geologic history, structure and tectonics, geologic hazards, topography, and minerals.

3.7.1 Geologic History

The rocks in the planning area vary in age from Precambrian to Holocene. The maximum total thickness of sedimentary section above the Precambrian is about 32,000 feet (Law et al. 1995). Tertiary and Quaternary formations dominate the surface units, with minor exposures of Precambrian, Paleozoic, and Mesozoic rocks.

The planning area contains a variety of geologic and structural features. A major part of the area lies within the northern portion of a large structural depression known as the Green River Basin. The exposed Eocene sedimentary rocks of the northern Green River Basin are bordered on the west by the Overthrust Belt and on the north and the east by the Gros Ventre and the Wind River Mountains.

The Overthrust Belt and the Gros Ventre Mountains, located on the western and the northern edge of the Green River Basin, respectively, are composed primarily of Paleozoic and Mesozoic marine sedimentary rocks. The Wind River Mountains, on the northeastern flank of the Green River Basin, are composed essentially of Precambrian igneous and metamorphic rocks that contain small quantities of gold, iron, thorium, molybdenum, and jadeite minerals.

Approximately 2 million years ago, climatic conditions changed dramatically. The climatic changes produced an increase in precipitation and cooler temperatures, which induced a series of glacial episodes in the higher elevations surrounding the Green River Basin. Glaciers advanced and retreated a number of times, bringing forth large amounts of rock debris from the mountains. These deposits are extensive along the foothills of the Wind River Mountains. Fremont Lake and all the large lakes on the west flank of these mountains are the result of these alpine glaciers, with glacial moraine deposits forming the dams on these natural reservoirs. Streams of melt water flowing from the glaciers reworked much of these morainal deposits into the alluvial terraces beyond the moraines. The baseball field above Pinedale is on one of these outwash terraces. The glacial erosion and deposition and the subsequent postglacial erosion and deposition have had a large influence on the creation of the present landforms of the planning area.

3.7.2 Structure and Tectonics

The planning area is located between two major structural provinces. The western side of the basin is bounded by the Darby and Prospect thrust faults of the Overthrust Belt. These faults mark the eastern boundaries of the Wyoming and Gros Ventre mountain ranges. These mountains were formed by north-south trending thrust faults with kilometer-scale eastward movement of Paleozoic and Mesozoic sedimentary rocks, a result of the Sevier Orogeny of the Cretaceous age. The eastern side of the Upper Green River Basin is bounded by the Wind River thrust fault. In this area, Precambrian rocks have been thrust toward the west over younger sedimentary rocks in a manner characteristic of the Laramide Orogeny of the late Cretaceous to early Tertiary age.

Major structural features within the planning area include the LaBarge Platform, the Pinedale Anticline, and the fault system that controls the Jonah gas field. The LaBarge Platform is the northern extension of a structural feature known as the Moxa Arch. The Moxa Arch-LaBarge Platform is a structural height that extends from southwestern Wyoming to the LaBarge area where it is truncated by thrust faults from the west. The Pinedale Anticline is found in the northeastern part of the area and generally parallels the Wind River thrust fault system. The asymmetric (steeper on the west side) anticline is 35 miles long and 6 miles wide (Law and Johnson 1989). The Pinedale Anticline was formed by compression associated with the

Wind River thrust fault system.

3.7.3 Geologic Hazards

Earthquakes and landslides are the prominent geologic hazards in the planning area. Landslide hazards are most commonly located on the western margin in the Wyoming Range where steep slopes and variable lithologies combine to produce significant landslide hazards. Based on U.S. Geological Survey (USGS) data, approximately 45,550 acres of high landslide susceptibility/moderate incidence and 71,250 acres of moderate susceptibility/low incidence occur on public surface within the planning area.

Most of Wyoming is classified by the USGS as an area of low to moderate seismic hazard. However, areas in the western portion of the state are classified as having a very high seismic hazard. The planning area is composed of areas of low to moderate seismic hazard, with high hazard areas in the western portions. Although seismic records show no major earthquakes within the planning area, major faults within the area could produce significant earthquakes. Large earthquakes have occurred nearby in Jackson Hole and Star Valley.

The BLM addresses the management challenges associated with geologic hazards through site-specific National Environmental Policy Act (NEPA) analyses for individual project proposals. When appropriate, the PFO develops mitigation measures to avoid and minimize impacts associated with geologic hazards.

3.7.4 Topography

The Green River Basin comprises most of the planning area and extends beyond its southern boundary. Relief in the area is moderate, with elevations ranging from approximately 6,500 feet in the southwestern corner up to 9,500 feet along some of the mountain fronts to the east, west, and north. Glacial features, mesas, and buttes form the most common topographic expressions across the planning area.

Two major river systems traverse the area: the headwaters of the Green River originate in the Wind River Mountains, and the Hoback River drains the northernmost portion of the planning area and eventually joins the Snake River. A topographic feature known as "The Rim" divides the Hoback and Green River drainages (Lageson and Spearing 1988). One major reservoir, the Fontenelle Reservoir, is located on the Green River on the extreme southern border of the planning area.

3.7.5 Minerals

The planning area contains approximately 1,199,280 acres of federal mineral estate underlying 922,880 acres of federally owned surface and 276,400 acres of private and state lands. As part of the Pinedale RMP revision effort, the Pinedale Mineral Occurrence and Development Potential Report (Mineral Report) was prepared (ENSR and Booz Allen Hamilton 2002). That report confirms that hydrocarbons are the most important mineral resources in the planning area. Gas from geologic formations other than coalbeds has the greatest development potential; gas from coalbeds, also referred to as coalbed natural gas (CBNG), is of lesser importance in the planning area.

Terms commonly used in the management of minerals within the planning area include the following:

- **Leasable fluid minerals** include oil and gas resources, geothermal resources, carbon dioxide, and helium.
- **Leasable minerals** include, but are not limited to, oil and gas, coal, oil shale, phosphate, and sodium brine. Leasable minerals are governed by the Mineral Leasing Act of 1920, as amended, which authorized specific minerals to be disposed of through a leasing system.
- **Locatable minerals** include uranium, gypsum, gold, and bentonite.

- **Salable minerals** include, but are not limited to, common varieties of sand, gravel, clay, boulders, and decorative rock (Maley 1977).

The following is a synopsis of mineral resources and development in the planning area. Refer to the Mineral Report for a thorough description of the mineral resources within the planning area.

Federal Oil and Gas Leasing

Existing oil and gas leases in the PFO do not differentiate between hydrocarbon products, such as oil, natural gas, natural gas from coal, natural gas separated for hydrogen sulfide, or other combinations of oil or gas. They simply authorize the leaseholder to explore for, develop, and produce whatever fluid mineral component may be contained within the formations within their lease.

Extraction and production of oil or natural gas from the various hydrocarbon-bearing zones in the leases in the planning area follow very similar processes (i.e., drilling the extraction hole, pumping for oil and some gas coalbed seams, separating any water produced with the hydrocarbon, and, in the case of natural gas, separating any liquid hydrocarbon and trucking or piping the product to a sales point and the produced water to a disposal facility). All of the extraction processes involve some kind of aboveground facility, which can vary from tank batteries for oil to separators, treaters, dehydrators, and storage tanks for natural gas. The size of the facilities can vary substantially depending on the production rate of the well and on other components produced with the hydrocarbon. For example, a low-production/low-water-producing well may have one small dehydration/separation/treater unit; whereas a hydrogen sulfide well may flow to a centralized plant or plants to remove the water, sulfur, and other components.

Because oil and gas leases do not differentiate between products and because of the basic similarities between developing the different fluid mineral products, unless stated otherwise, the term oil and gas or fluid minerals in this document will collectively apply to all fluid mineral products occurring within the planning area.

Federal oil and gas resources administered by BLM are categorized into one of four groups: lands available for leasing with standard stipulations; lands available for leasing with minor restrictions, such as seasonal stipulations or CSU; lands available for leasing with major restrictions, such as NSO; and lands not available for leasing.

Surface use restrictions (including NSO, CSU, and no leasing) cannot be retroactively applied to existing valid oil and gas leases or other existing valid use authorizations. Site-specific postlease actions (e.g., applications for permit to drill [APD] and ROWs) in areas with existing valid rights would be allowed, subject to surface use restrictions on a case-by-case basis, as supported through project-specific NEPA analysis.

The public can nominate any federal lands with unleased federal minerals and/or any split-estate lands underlain with unleased federal minerals to be included in one of the six competitive lease auctions held yearly by the BLM Wyoming State Office. When a parcel is nominated for lease, it is evaluated using a Determination of NEPA Adequacy (DNA) to determine whether the RMP NEPA document prepared is adequate and whether subsequent use planning decisions are appropriate to allow oil and gas leasing where the individual parcels are located. If the parcel is located in an area designated not available for leasing, it is removed from the nomination list. Stipulations are placed on the parcels based on RMP decisions. Parcels with stipulations are posted for a 45-day review period before the lease auction. When a lease is issued, it is valid for 10 years. If the parcel is not developed with at least one producing well within the 10-year period, the lease expires and the parcel can be renominated. Parcels developed with at least one producing well do not expire while the wells continue to produce.

Based on the Mineral Report for the planning area, 287,230 acres were nominated and offered for lease between 1996 and 2001. As of June 2004, approximately 1,174 BLM-administered federal oil and gas

leases covered 734,020 acres, or approximately 61% of the federal mineral estate in the planning area.

The planning area currently has several areas not available for oil and gas leasing: the Scab Creek WSA (7,710 acres), Lake Mountain WSA (13,490 acres), Deadline-Graphite elk winter range (22,690 acres), a Native American funerary site (440 acres), a Native American Religious Concern Site (120 acres), and the Wind River Front leasing moratorium area (243,040 acres of federal surface and mineral estate). The Wind River Front area includes the Scab Creek WSA and Detachment 489 of the U.S. Air Force. The leasing moratorium was imposed in July 2000 and remains in effect pending a decision in this RMP to extend, suspend, or modify the moratorium. Air Force Detachment 489 is located 6 miles east of Boulder, Wyoming, and was established in 1959 as part of the Air Force's United States Atomic Energy Detection System. The detachment was closed in 1986 because of funding issues but was reopened in 1989 as a seismic research facility. Before the closure in 1986, personnel from the detachment were working with personnel from the PFO to incorporate the oil and gas leasing and geophysical exploration exclusion area into the RMP being prepared at that time. The proposed exclusion area included a 10-mile radius around the sensor sites. However, with the closure in 1986, the proposal was dropped from the RMP.

In 1990, on the basis of an internal Air Force memorandum, the Air Force Technical Applications Center of Patrick Air Force Base, Florida, again identified a need to establish a 10-mile oil and gas leasing and geophysical exploration permitting exclusion area around the monitoring sensors at Detachment 489. In 1996, the detachment became part of the United Nations Comprehensive Nuclear Test Ban Treaty's International Monitoring System network of worldwide nuclear monitoring sites. A formal request for a 10-mile exclusion area was not submitted to the PFO until April 1998. By that time, parcels had been leased to within 6 miles of the detachment. Subsequent to the 1998 Air Force request, BLM geologist Phil Howland conducted a geological analysis of the detachment area and the proposed exclusion area. The analysis concluded that the granite-based Wind River Thrust Fault extends 5 to 6 miles west of the detachment and that oil and gas drilling and geophysical exploration activities should be excluded from this formation owing to its noise transference capabilities. The report also concluded that the area beyond the Wind River Thrust Fault was made up of sandstones and shales with much slower noise transference rates and therefore should be available for leasing and geophysical exploration. In January 1999, the Air Force contracted the request for exclusion to a 6-mile radius. The 6-mile area was incorporated into the temporary Wind River Front leasing moratorium area.

Current Oil and Gas Development Areas

Based on statistical data in the Mineral Report, the hydrocarbon resources within the planning area may be placed within one of the following categories for potential development: very high, high, moderate, low, very low, and no potential for development. The potential within each of these categories is determined by the following criteria (ENSR and Booz Allen Hamilton 2003):

- Very high potential for hydrocarbon development indicates areas in which average well density is anticipated to be more than 500 wells per township (36 square miles) (34,630 acres are currently leased within these areas).
- High potential for hydrocarbon development indicates areas in which average well density is anticipated to be more than 100 wells per township (84,080 acres are currently leased within these areas).
- Moderate potential for hydrocarbon development indicates areas in which average well density is anticipated to be 20 to 100 wells per township (349,040 acres are currently leased within these areas).
- Low potential for hydrocarbon development indicates areas in which average well density is anticipated to be less than 20 wells per township (181,260 acres are currently leased within these areas).

- Very low potential for hydrocarbon development indicates areas in which average well density is anticipated to be less than two wells per township.
- No potential for hydrocarbon developments indicates areas in which no wells are anticipated (1,670 acres are currently leased within these areas).

More detailed information about the oil and gas resource, as well as other minerals, may be obtained from the Mineral Report. This includes additional information on the potential for hydrocarbon occurrence and development.

Oil and gas drilling activity in the planning area is concentrated in three main areas (Map 3-5) (ENSR and Booz Allen Hamilton 2002). Brief summaries of these three drilling and production regions follow; see Wyoming Oil and Gas Conservation Commission information and well data as of April 2006:

- **Greater Big Piney-La Barge.** A number of fields in this vicinity have grown into one large producing area, with a cumulative completion of more than 1,500 wells. To date, these fields have produced most of the oil and gas in the planning area. Production of carbon dioxide for use in secondary oil recovery operations also takes place in this region.
- **Jonah Field.** More than 650 wells have been completed in this field. Most of these wells are producing.
- **Pinedale Anticline.** More than 400 active production wells are currently on the anticline. Production from this field is increasing rapidly.

Oil and gas drilling activity in the planning area can be partially characterized as follows:

- Total number of producing and shut-in oil and gas wells—2,970 (WOGCC 2006)
- Total oil production from January 1978 to March 2006—62.5 million barrels (WOGCC 2006)
- Total oil production from March 1996 to March 2006—33.5 million barrels (WOGCC 2006)
- Annual average oil production from March 1996 to March 2006—3.3 million barrels (WOGCC 2006)
- Total gas production from January 1978 to March 2006—8 trillion cubic feet (TCF) (WOGCC 2006)
- Total gas production from March 1996 to March 2006—5 TCF (WOGCC 2006)
- Annual average gas production from March 1996 to March 2006—503 billion cubic feet (BCF) (WOGCC 2006)
- Total water production from January 1978 to March 2006—212.2 million barrels (WOGCC 2006)
- Total water production from March 1996 to March 2006—91 million barrels (WOGCC 2006)
- Annual average water production from March 1996 to March 2006—9.1 million barrels (WOGCC 2006)
- Total value of oil production between 1995 and 1999—estimated at $116 million (2001 dollars) (WOGCC 2006)

- Total value of gas production between 1995 and 1999—estimated at $2 billion (2001 dollars) (WOGCC 2006)
- Total oil and gas royalties—estimated at $256 million (2001 dollars) (WOGCC 2006)
- Total taxes generated to county, state, and federal governments—estimated at $533 million (2001 dollars) (WOGCC 2006)
- Annual average taxes from oil and gas during the past 5 years—estimated at $107 million (2001 dollars) (WOGCC 2006)
- Average mining industry sector employment during the past 10 years in the socioeconomic study area of Sublette, Lincoln, and Sweetwater counties—5,700 people (predominately Sweetwater County)
- Peak mining industry sector employment during the past 10 years in the socioeconomic study area—6,378 people.

Development of CBNG in the planning area is at a very early stage. To date, nine CBNG wells have been drilled into coalbeds (five in federal minerals and four in fee minerals). These wells, in the Riley Ridge Field area of T29 and 30N, R114W, are between 3,400 and 4,100 feet deep. The CBNG well pads are slightly smaller, but otherwise very similar to pads constructed for deeper wells. The coal depths for CBNG development in the planning area are typically deeper than those in the Powder River Basin, thus requiring larger drilling equipment, such as conventional truck-in and assemble drill rigs or large Ellenberg-style mobile drill rigs, to reach the deeper coal depths. To support this type of equipment, a constructed and leveled pad is needed. A reserve pit is typically included on the pad for the drilling water, drill cuttings, and mud disposal.

The extraction of CBNG often involves pumping large amounts of water in the initial stages of development to lower hydrostatic pressure. The quality of the extracted water resource varies, and options for its disposal are highly dependent on its quality and economics. The disposal method currently used in the planning area is to reinject produced water into zones with equal or poorer quality water than that from the production zone. Exceptions could be granted on an individual well basis if the water in question contained less that 500 ppm total dissolved solids; had a defined beneficial use associated with a responsible party; met all EPA, Department of Environmental Quality (DEQ), and other agency standards; and had an approved disposal plan for excess water beyond that required for the beneficial use. No discharge into surface water features, including ephemeral channels, is taking place. Under all disposal options, operators must obtain all necessary state permits.

A significant percentage of nonhydrocarbon gas is produced from the Madison Limestone. Carbon dioxide, nitrogen, hydrogen sulfide, and helium are separated from the hydrocarbon gas during processing at the Shute Creek Gas Plant (USDI, BLM 2002).

Directional drilling or drilling multiple gas wells from a single, larger pad is taking place in the Jonah and Anticline fields and to a lesser extent in the Big Piney-LaBarge area. Directional drilling can reduce impacts on surface resources, such as vegetation, soil, livestock grazing, wildlife habitat, and visual and recreational values. Depending on the subsurface geology, as many as 8 wells have been drilled from a single pad in the planning area, and proposals have been submitted to potentially drill as many as 21 wells from a single pad. Centralizing the surface locations reduces fragmentation of wildlife habitat and disturbance of surface vegetation and soils. Fewer miles of roads and pipelines are necessary, and in some cases, facilities such as reserve pits have been shared among multiple well pads. Directional drilling can substantially increase the costs required to develop wells because of increased drilling time, sticking of casing at the bends in the well-bore, and loss of a percentage of wells (when sticking or other drilling problems cannot be remedied). In addition, seasonal restrictions may be a deterrent to or may completely

preclude directional drilling in cases where drilling one or more directional wells from a single pad would take longer than the seasonal drilling window allows. Directional drilling is also limited by the horizontal reach possible for each site. Factors that typically limit the horizontal reach include the total well depth and the thickness of the target formation. Generally, the horizontal reach for most directional wells in the planning area has been about one-quarter mile or less. However, wells with horizontal offsets of 2,500 feet or greater have been drilled.

Other Minerals

The development potential of solid minerals within the planning area (i.e., minerals other than oil and gas) is limited by several factors, the most prominent being an unfavorable geologic environment for the occurrence of many minerals. In addition, mineralized zones that have been discovered exhibit characteristics such as limited or discontinuous mineralization, inherent impurities, and/or low percentage content of the target mineral.

Salable Minerals

Salable minerals known to occur within the planning area are limited to aggregates (e.g., sand and gravel, common-variety limestone) and decorative stone (moss rock and boulders). These commodities are classified as industrial minerals and have a low per-unit valuation. As long as the development potential remains limited and the unit valuation remains low, nonfluid minerals are not expected to be significant contributors to the economic minerals sector of the local economy.

Increased oil and gas exploration, development, and production have had little effect on the amount of aggregate produced from public lands because of seasonal restrictions for development and the availability of aggregate from private pits located closer to the places where it is used. If BLM were to provide aggregate from an all-season pit or pits located more strategically to the gas fields, production increases would be anticipated.

Extensive deposits of sand and gravel are found along major drainages in the planning area. Past use of aggregate has been for highway construction and, to a much lesser extent, surfacing of drill roads and pads in the rapidly developing gas fields in the area.

Decorative building stone is found in the foothills on both sides of the planning area. The most extensive production has come from lichen-covered granite boulders in glacial moraines on the east side and from platy sandstone of the Nuggett Sandstone in the Miller Mountain/LaBarge Creek area on the west side. “Moss rock” located in the Lake Mountain WSA is currently unavailable for sale under the IMP for lands under wilderness review.

Locatable Minerals

Locatable minerals, such as copper and gold, have been found only in very small, noncommercial concentrations in the planning area. No activity related to the extraction of these minerals currently exists, and none is anticipated in the future.

There are currently no producing mines, and there has been little mining historically in the planning area. The potential for mining of any locatable mineral is low because the geologic environment within the planning area is not favorable for such deposits.

Solid Leasable Minerals

Coal

The coal development potential for the planning area is considered low. Factors contributing to the low potential include the poor quality of the coal, as well as the depth to and thickness of the coal seams; coal seams in the planning area are usually less than 3 feet thick.

Coal production in the area has been predominantly from numerous very small underground operations. Generally, these mines supplied coal to a limited local market. There are no producing coal operations within the planning area at this time. The last known coal production reported for the general area was 284 tons from the Cottonwood Mine (T33N, R115W, Sec. 4) in 1963. That mine did not produce after that year and is presumed to have closed sometime in 1964. There are no known areas with coal development potential in the planning area.

Several coal seams have been discovered below 5,000 feet in the Fort Union Formation through drilling in association with the development of the Pinedale Anticline and Jonah Fields; however, coal mining or producing CBNG at these depths has not proven to be economically viable with today's technology. There are currently no federal coal leases within the planning area, and no interest has been expressed by anyone to obtain new leases.

Sodium

The Wilkins Peak Member of the Green River Formation is rich in trona, a sodium carbonate mineral derived from evaporation of Eocene lake beds and precipitation of the dissolved minerals. These deposits are found primarily south of the planning area, and active trona mining presently occurs in the central portion of the Green River Basin west of the City of Green River. No known production of sodium mineral or brine deposits has occurred within the planning area or will likely occur at anytime in the future.

Phosphate

The planning area has a modest reserve of phosphate rock. No production of the phosphate resource has taken place in the planning area, and development of the phosphate deposits is not likely to occur in the foreseeable future.

Phosphate resources in the planning area occur in thin beds found in the Permian Period Phosphoria Formation. Lands presumed to contain phosphate deposits were withdrawn from location under the Mining Laws for nonmetalliferous minerals by an Executive Order issued under the authority of the Pickett Act, pending classification with regard to phosphate values. Portions of these withdrawals currently remain in effect and contain approximately 1,190 acres within the planning area (Map 3-3).

The subsurface presence of the Phosphoria Formation in the planning area has been well established by drilling. A surface exposure containing fairly rich phosphate beds at Deadline Ridge (Sections 5, 8, and 17, T27N, R114W, and Sections 1 and 2, T27N, R115W) is described by Sheldon et al. (1952). Total thickness of the Phosphoria Formation at this location is about 360 feet, consisting of three units: the Phosphatic Shale Member, the Rex Chert Member, and the Upper Shale Member. These rocks are contained within the east limb of a large northwest-trending synclinal fold. Phosphate beds are exposed along the west slope of Deadline Ridge where the bedding planes dip at about 40 degrees to the southwest, approximately parallel to the slope of the topography.

Oil Shale

The Eocene Green River Formation contains a few deposits of thin, low-grade oil shale in the extreme south-central part of the planning area. Lands presumed to contain oil shale deposits were withdrawn from location under the Mining Laws for all minerals by Executive Order 5327 and by Public Land Order (PLO) 4522, pending classification with regard to oil shale values. These withdrawals are outside the planning area.

In the planning area, there are three named units within the Green River Formation: the Fontenelle Tongue, the Middle Tongue (Wilkins Peak Member), and the Upper Tongue. The richest oil shale beds are found in the lower part of the Middle Tongue (Oriel 1969). Numerous excellent exposures of the Middle Tongue occur within the Fort Hill Quadrangle along Muddy Creek near the Facinelli Ranch, in cliff exposures around the Fontenelle Reservoir, and along the Green River near LaBarge. There has been

no known commercial production of shale oil from oil shale occurrences within the planning area.

As indicated in Section 3.1.4 of the Mineral Report, the Green River Formation oil shale deposits are thickest and richest in the southern part of the Greater Green River Basin. Accordingly, those occurrences within the planning area occur along the basin margins, where the Green River Formation contains only small amounts of oil shale, most of which is low grade.

Although the planning area does contain limited oil shale resources, there are more extensive and higher-grade deposits in other parts of the Greater Green River Basin in Wyoming, the Piceance Basin in Colorado, and the Uinta Basin in Utah. Anadarko Petroleum Corporation has filed an application for a parcel of public land about 35 miles southeast of Rock Springs in the Washakie Basin. This research proposal is tied to the Energy Policy Act of 2005, which calls for commercial oil shale leasing on public lands to begin in 2007. Any future commercial exploitation of oil shale, if it were to occur, would likely take place in those parts of the Greater Green River Basin in which the more extensive and higher-grade deposits occur. However, production of kerogen, or shale oil, remains in the developmental stages and is considered infeasible at this time.

The nature of the oil shale deposits within the planning area, in conjunction with the status of oil shale development in general, suggests that there is low to no potential for commercial exploitation of these oil shale deposits in the foreseeable future.

Potassium

There are no known occurrences of potassium deposits within the planning area.

Geothermal

The Joint Geothermal Programmatic EIS for Public Lands and National Forest System Lands in the Western States and Alaska has identified 704,329 acres as having potential for containing geothermal resources. The Programmatic EIS will guide geothermal leasing standards. There are no existing or proposed geothermal leases or projects in the planning area.

3.8 PALEONTOLOGY AND NATURAL HISTORY

Rock units representing more than 500 million years of geologic time are present in the planning area. Many of these units contain paleontological resources. The potential for a given geologic formation to contain paleontological resources varies by formation and age. As the potential for paleontological resources increases, the need for mitigating surface disturbing activities also increases.

BLM has classified geologic formations in the planning area according to the probable fossil yield classification (PFYC). This is a planning tool that classifies formations according to the probability of yielding paleontological resources that are of concern to land managers. Existing regulations and policies address the collection and preservation of fossils found on public lands. Common varieties of invertebrate and plant fossils are available for hobby collecting. No commercial collection of any fossils is permitted. Paleontological resource use permits are required for the collection of significant fossils. All vertebrate fossils and, in rare cases, invertebrate or plant fossils are deemed significant under current policy. Significant invertebrate or plant localities are treated on a case-by-case basis, but vertebrate fossils are more widespread and predictable. The following classification is based largely on how likely it is that a geologic unit will produce vertebrate fossils. The classes are described in Table 3-10, with some examples of corresponding management considerations or actions.

Table 3-10. Paleontological Classification Descriptions

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

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

Source: Originally developed by the Paleontology Center of Excellence and the Region 2 (USFS) Paleo Initiative, 1996. Some modification by Dale Hanson, Regional Paleontologist, Wyoming BLM, 2002.

Appendix 22 contains a list of geologic formation classifications, according to the PFYC, for the State of Wyoming. There are more than 475,000 acres of PFYC Class 4 and 5 within the planning area. Site-specific conditions determine the distinction, and therefore the level of mitigation, between Class 4 and 5; these classes are combined for this level of analysis. There are more than 45,000 acres of PFYC Class 1; more than 230,000 acres PFYC Class 2; and more than 160,000 acres of PFYC Class 3 in the planning area.

The PFYC is based on probabilities, not certainties or special circumstances. There will be exceptions to each criterion used as the basis for classification. These are expected and are handled as unique situations. Mitigation for these situations is handled on a case-by-case basis, as needed.

The geologic units containing paleontological resources span from 544 million years old to 10,000 years old. Table 3-11 shows the paleontological resources contained within geologic units of varying age throughout the planning area.

Table 3-11. Paleontological Resources Contained Within Geologic Units

Paleontological Resources Contained Within Geologic Units
Precambrian Era (4.6 billion to 544 million years ago) The Precambrian rocks located within the area contain no paleontological resources.
Paleozoic Era (544 million to 245 million years ago) The Paleozoic Era is divided into seven periods: Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and Permian.
Cambrian Period (544 million to 505 million years ago) The Cambrian Formations present in the planning area include the Flathead Sandstone, the Gros Ventre Formation, and the Gallatin Limestone (Love et al. 1993). • **Flathead Sandstone**. Noteworthy invertebrate fossils have not been reported from the Middle Cambrian Flathead Sandstone (Daitch and Robinson 2002). Brachiopods are known to occur in several localities throughout Wyoming. • **Gros Ventre Formation**. Invertebrate fossils are known to occur in this formation, including trilobites. • **Gallatin Limestone**. Noteworthy invertebrate fossils are known to occur within the formation.
Ordovician Period (505 million to 440 million years ago) There are no formations of Ordovician age in the planning area.
Silurian Period (440 million to 410 million years ago) There are no formations of Silurian age in the planning area.
Devonian Period (410 million to 360 million years ago) The Upper Devonian Darby Formation has been assigned a Class 3 paleontology potential throughout Wyoming. Fossils in the Upper Devonian Darby Formation include several invertebrate groups and conodonts (Daitch and Robinson 2002).
Mississippian Period (360 million to 325 million years ago) The Mississippian Madison Limestone has produced abundant invertebrates, including mollusks, crinoids, brachiopods, and corals.
Pennsylvanian Period (325 million to 286 million years ago) There are no paleontological resources of the Pennsylvanian Period in the planning area.
Permian Period (286 million to 245 million years ago) There are no paleontological resources of the Permian Period in the planning area.
Mesozoic Era (245 million to 65 million years ago) The Mesozoic Era is often referred to as the "age of dinosaurs." The Mesozoic is divided into three periods: Triassic, Jurassic, and Cretaceous.
Triassic Period (245 million to 208 million years ago There are no paleontological resources of the Triassic Period in the planning area.
Jurassic Period (208 million to 146 million years ago) There are two Jurassic-age formations mapped in the area: the Stump Sandstone and the Morrison Formations. Both units have the potential to produce significant fossils in the area. • **Stump Sandstone**. Rare fossil vertebrates have been reported in the Middle to Upper Stump Sandstone sediments, and both invertebrate and trace fossils have been reported in abundance (Daitch and Robinson 2002). • **Morrison Formation**. The Morrison Formation is well known for producing significant and highly diverse fauna and flora that include mollusks, fish, trace fossils, as well as various dinosaurs, such as *Camptosaurus*, *Allosaurus*, *Brachiosaurus*, *Apatosaurus,* and *Stegosaurus* (Jenkins and Jenkins 1993, Turner and Peterson 2002).
Cretaceous Period (146 million to 65 million years ago) There are two geologic units of Cretaceous age in the area: the Mesa Verde Formation and the Lance Formation. Both formations have a moderate to high potential to produce significant vertebrate fossils in the planning area. • **Mesa Verde Formation**. Represents a lowland environment and contains plant and invertebrate fossils. • **Lance Formation**. Deposited from a braided stream environment and contains vertebrate and plant fossils.

Paleontological Resources Contained Within Geologic Units
Cenozoic Era (65 million years ago to present day) The Cenozoic Era, also known as the "age of mammals," spans from 65 million years ago to the present day. The Cenozoic is broken into two periods of geologic time, the Tertiary and the Quaternary. Because of a more complete fossil record, the Tertiary Period can be broken down further into five epochs: Paleocene, Eocene, Oligocene, Miocene, and Pliocene. The Quaternary Period is broken into two epochs: the Pleistocene and Holocene (or Recent; the current period of geologic time). A discussion of the paleontological resources of the Cenozoic age contained within the planning area is presented below.
Tertiary Period (65 million to 1.8 million years ago) Highly significant paleontological resources of Tertiary age are found in the planning area. • **Paleocene Epoch (65 million to 54 million years ago).** One geologic formation of Paleocene age, the Fort Union, is present in the area. In addition, the Pinyon Conglomerate may be in part Paleocene in age, and the Chappo Member of the Wasatch Formation may contain mammalian fauna of mid- to late-Paleocene age. • **Fort Union Formation**. This formation was formed in a deltaic environment and contains vertebrate and invertebrate fossils. • **Eocene Epoch (54 million to 38 million years ago).** Formations of Eocene age in the planning area include the Wasatch and Green River (Bradley 1964). These formations were deposited somewhat contemporaneously and contain rich vertebrate remains; thus, they have similarly high Paleontological Class designations (4 or 5). • **Wasatch Formation**. Much of the Wasatch Formation is considered Lower Eocene, although a mid- to late-Tiffanian (mid- to late-Paleocene) mammalian fauna is known from the Chappo Member (Gunnell 1994) and a middle Eocene mammalian fauna has been reported from the Cathedral Bluffs Tongue (West and Dawson 1973). The Wasatch Formation contains a well-preserved record of vertebrate fossils, including fish, reptiles, birds, and mammals, as well as invertebrate and plant fossils. A large body of literature has been published on the Wasatch Formation (e.g., McKenna 1960, West 1969, West and Dawson 1973, Dorr 1978, Gingerich and Dorr 1979, Gauthier 1982, Roehler et al. 1988, Gunnell 1994). • **Green River Formation**. The Green River Formation represents one of the most important Eocene deposits in the world. It is famous for well-preserved mammal, fish, turtle, bird, snake, insect, and plant fossils. Grande (1980) reviewed important fish and other vertebrate fossil discoveries.
Oligocene, Miocene, or Pliocene Epochs (38 million to 1.8 million years ago) There are no paleontological resources of Oligocene, Miocene, or Pliocene Epochs in the planning area.
Quaternary Period (1.8 million to present day) The Quaternary is broken into two epochs: Pleistocene (the time of the "ice ages"), and Holocene. Rare vertebrate fossils have been recorded from the alluvium and colluvium in the planning area.

The potential for continued discovery of significant paleontological sites, especially in the Wasatch and Green River Formations, is high. Several important fossil quarry sites in these formations exist in the Green River Basin and Fossil Basin areas, including Fossil Butte National Monument, but no such quarry sites are located in the planning area. Many scientifically important localities, however, are known in the planning area.

3.9 RECREATION AND VISITOR SERVICES

With a major river system (the Upper Green River) and several major mountain ranges, the planning area is a popular recreation area, both locally and nationally. Outdoor recreational activity is steadily increasing in types of activities and intensity of use. This increase in recreational use is presenting challenges to managing such use to accommodate the demands on recreational resources and simultaneously preserve those resources.

3.9.1 Resource Setting and Description

The planning area is located in western Wyoming, approximately 100 miles south of Yellowstone and Grand Teton National Parks. The area, which lies within the Upper Green River watershed, is bounded on the north and west by the Bridger-Teton National Forest and on the east by the Bridger-Teton National Forest and Bridger Wilderness area. The BLM lands located in the foothills of the Wyoming and Wind River Mountain Ranges provide important public access and opportunities to recreate in a predominately undeveloped setting. Outdoor recreation and tourism have historically been integral to the social character and economic wellbeing of people in the planning area. The planning area possesses a diversity of landforms and topographical features capable of supporting many types of recreational opportunities. Visitors participate in a wide variety of activities over a broad area. Recreational activities available within the planning area include big game hunting (e.g., elk, mule deer, moose, and pronghorn), small game hunting (e.g., grouse and waterfowl), fishing, river rafting, canoeing, lake boating, camping, backpacking, horsepacking, cross-country skiing, OHV use (including snowmobiling), rock collecting, sightseeing of historic trails and other scenic places, wildlife viewing, and photography.

Specific recreational resources in the planning area include special recreation management areas (SRMA), extensive recreation management areas (ERMA), and developed recreation sites (Map 3-6). A SRMA is an area with a commitment to provide specific recreational activities and opportunities. These areas usually require a high level of recreational management. An ERMA is an area not specifically designated as a SRMA and includes all BLM-administered lands outside SRMAs where dispersed recreation activities generally occur. Eight developed recreation sites are within the planning area:

- **Warren Bridge Campground.** As part of the Upper Green River SRMA, this campground is located about 20 miles north of Pinedale, at the point where US Highway 191 crosses the Green River. This fee site consists of developed campsites with water, picnic tables, fire pits, restrooms, and a waste dump station.

- **Warren Bridge, River Access Area**. Located just upstream from the Warren Bridge Campground is a complex of 11 developed camp and boating river access sites. This popular area provides opportunities for riverside camping and easy access along 9 miles of the Green River for fishing, hunting, boating, and OHV activities. Facilities at each site include restrooms, fire rings, and picnic tables.

- **Boulder Lake Recreation Area**. This area includes the following recreation sites:
  - **Boulder Lake Campground.** Located on the north shore of Boulder Lake, this recreational site includes undesignated sites, picnic tables, and restrooms.
  - **Boulder Lake Boat Access.** Located on the South Shore of Boulder Lake, this site provides concrete boat ramp and dock facilities, parking, restrooms, and area use information.
  - **Stokes Crossing Campground.** Stokes Crossing campground is located 2 miles southwest of Boulder Lake along Boulder Creek. Recreational development at this site consists of several undesignated sites, picnic tables, and a restroom.

- **New Fork Campground.** This campground is located on Wyoming State Highway 351 where the highway crosses the New Fork River. This site consists of camp and picnic sites and restrooms.
- **Scab Creek Campground.** This campground is located near the Scab Creek WSA, approximately 12 miles northeast of Boulder. This site consists of camping and picnic sites, restrooms, and a horse corral. The Scab Creek Trail, a major access to the Bridger Wilderness, originates in this area.
- **CCC Pond Recreation Area.** This recreation area is located within walking distance of Pinedale and consists of a walking path, ski trail system, fishing ponds, restroom, and interpretive facilities.

Other designated recreational areas include the Continental Divide Snowmobile Trail system and the National Historic Oregon Trail (Lander Trail). Interpretive sites along the Lander Trail and at other locations inform visitors about the fur trapping era and western explorers and area settlement. Trapper's Point and the DeSmet Monument are two interpretive sites on public lands that depict significant information relative to the "rendezvous" of the mountain men on the Upper Green River.

3.9.2 Recreational Use

Population growth in the West and Southwest and recent population shifts to these regions have produced an increasing demand for recreational uses on public lands. Given the diversity and availability of resources found on public lands, lands administered by the BLM have become important destinations for those seeking outdoor recreation opportunities. The BLM General Recreational Policy Statement supports BLM's goal of multiple use and sustained yield of BLM-administered public lands (USDI, BLM 1990a). As recreation demand increases in conjunction with the demand to use public lands for other purposes, conflicts between traditional recreation use and other land uses are expected. A challenge of major concern to the BLM is how best to manage recreation use in a manner that maximizes recreation benefits in the presence of changing populations and landscapes.

Visual resources (Section 3.14) are relevant to recreational activities in several ways. Sightseeing is a recreational activity that depends on the quality of visual resources. Some recreation activities, such as river floating and hiking, are enhanced by a high degree of visual quality. Activities, such as road building, oil and gas development, OHV use, and other surface disturbing activities, have an impact on visual resources and therefore on recreational opportunities and experiences.

Noise, as it affects recreational opportunities, is usually considered to be intrusive. As population growth and industrial development continue to increase, noise in rural and primitive areas becomes more evident.

The heaviest use of the developed recreation areas occurs during the summer months, from mid-June until the end of September. The most popular summer activities include hunting, fishing, sightseeing, float or raft trips, mountain/rock climbing, and hiking. Winter is a fast-growing use season for snowmobiling and cross-country skiing.

Hunting and Wildlife Viewing

Hunting and wildlife viewing are widespread throughout the planning area. The best source of hunting data is the Wyoming Game and Fish Department (WGFD), which monitors hunting use within hunt areas that are fully or partially included in the BLM planning areas. The presence and variety of wildlife add to the recreation experience in this area. Most visitors using public lands in this area for camping, hiking, or floating, benefit from opportunities to observe wildlife.

Camping

Demand for camping opportunities in the planning area appears to be growing. A great amount of unregulated, dispersed camping occurs in the ERMA outside developed camping areas. The ERMA provides the greatest amount of land available for recreation activities. The Wyoming Range Front area likely receives the most concentrated amount of dispersed recreation, especially after the snow is gone until mid-fall. Also, BLM-administered land adjacent to the Green and New Fork Rivers attracts campers throughout the summer months. The demand for dispersed camping opportunities is becoming more evident as developed facilities approach and often exceed capacity. Recreational camping by retired people and those seeking a more motorized recreation experience appears to be the fastest growing segment of camping enthusiasts. People seeking long-term camping opportunities have increased substantially. This is due in large part to the lack of affordable housing for those either working in or seeking employment by the fluid mineral industry. Within developed camping areas, Warren Bridge campground and day use area is especially popular for the traveling public. Of all developed recreation facilities in the planning area, the Warren Bridge River access area receives the greatest amount of visitation for camping and day use activities. The Scab Creek Recreation Area receives an exceptional amount of day use associated largely with the Bridger Wilderness. The amount of camping in the Scab Creek Recreation Area is greatest during the fall and is generally associated with those hunting in the nearby Scab Creek WSA. The Boulder Lake Recreation Area attracts most notably day-use visitors to boat and fish Boulder Lake and Boulder Creek, as well as moderate levels of developed and dispersed camping during mid to late summer. The New Fork River Campground is used heavily during the summer months for fishing access but most notably throughout the year as a wayside rest area by people employed in the nearby gas fields.

Water-Related Recreation

River and lake recreation use have increased substantially, prompting the need for additional access and better facilities. Float fishing and wade fishing are likely the most sought-after water-related recreational activities. Approximately 187 miles of the Green and New Fork Rivers are floatable within the planning area. The Upper Green River SRMA is very popular as a destination for those people seeking unrestricted access for scenic floating, fishing, camping, and hunting. Wade and float fishing is the major recreation activity associated with this segment of the river. Important boating access to downstream river segments is also provided. An increasingly popular activity is long distance river floating and camping. Individuals and groups seek the opportunity to float the entire river or long segments, necessitating overnight campsites. This opportunity is somewhat limited because the middle portion of the Green River lacks public access. The lower Green River, south of Highway 351, is emerging as a portion of the river capable of providing additional river-related recreation opportunities.

The Green and New Fork Rivers and their tributaries are some of the most heavily visited fishing waters in the planning area, but access is quite limited and minimally regulated. The scenery along these waterways is characterized by a relatively undeveloped river corridor with healthy riparian habitat and expansive and colorful bluffs amid evidence of some agricultural developments. Floaters can view waterfowl, moose, deer, raptors, and many other bird and animal species. Land in the river corridor is mostly privately owned; however, the majority of BLM land is accessible by roads and trails. Many of the river access points are undeveloped, and public lands are unmarked. BLM river access points, although limited, provide substantial access for private and commercial river-related recreation.

Many other stream segments within the planning area provide fishing and camping opportunities. Boulder Lake provides recreational opportunities for wade fishing, boating, and camping (see additional discussion in Section 3.18, Special Designations and Management Areas).

Shed Antler Collecting

Shed antler collecting is an increasingly popular recreational and commercial activity. This activity may be affecting the wintering herds of elk and mule deer. Shed antler collecting and human presence in the winter on crucial winter ranges is becoming a problem because it adds to the stress level of wintering deer and elk.

Special Recreation Use Permits

The BLM issues commercial permits to 43 operators serving clients associated with big game hunting, fishing, and competitive and group activities on public lands within the planning area. There is a growing interest in other types of commercial recreation use in the planning area. Examples of these activities include guided backcountry horse touring, touring historic features such as the Lander Trail, and viewing wildlife.

Scenic Byway

US Highway 191 north from Pinedale to Dubois, Wyoming, is designated as the Wyoming Centennial Scenic Byway. This byway is being managed to promote the history, culture, and special features unique to this beautiful region of the Rocky Mountains. Numerous interpretive sites located on BLM lands are identified in conjunction with the byway as well as associated publications.

The Recreation Opportunity Spectrum

The recreation opportunity spectrum (ROS) is a method widely used by the BLM and other land management institutions to characterize recreation opportunities in terms of setting, activity, and experience opportunities. The classification of opportunity experiences and settings range along a continuum from primitive to urban. The BLM uses this classification system as a tool to develop management actions that achieve desired recreation outcomes in terms of benefits, experiences, and activities. The goals of the ROS system are to (1) establish outdoor recreation management goals and objectives for specific areas, (2) allow for modification of recreational opportunities when other resource management actions are needed, and (3) establish standards for an area that would allow monitoring of the recreational experience and opportunity setting. The current ROS management system used for the planning area is depicted as Natural Resource Recreation Settings in Appendix 16. The ROS categories are generally described as follows:

- **Primitive-characterized.** Characterized by a roadless, essentially unmodified natural environment. Activities might include camping, hiking, enjoying scenery or natural features, photography, hunting, swimming, diving, fishing, canoeing, sailing, and river running (nonmotorized craft).
- **Back country-characterized.** Characterized by a roadless, predominantly unmodified natural environment. Activities might include camping, hiking, enjoying scenery or natural features, photography, hunting, swimming, fishing, canoeing, sailing, and river running (nonmotorized craft).
- **Middle country-characterized.** Same as semiprimitive, except motorized use is permitted.
- **Front country-characterized.** Characterized by a generally natural environment, with evidence of resource modification and utilization harmonizing with the natural environment. Motorized travel is permitted.
- **Rural.** Characterized by a substantially modified natural environment. Activities might include camping, hiking, enjoying scenery or natural features, photography, swimming, fishing, canoeing,

sailing, river running (motorized craft), power boating, picnicking, rock collecting, wood gathering, auto touring, water skiing and other water sports, interpretive services use, rustic resorts and organized camps, competitive games, spectator sports, bicycling, jogging, outdoor concerts, and modern resorts.

- **Urban.** Characterized by a substantially modified natural environment that can no longer be classified as "rural." For the purposes of this planning document, "urban" landscapes include not only towns and housing subdivisions but also industrialized landscapes such as intensively developed natural gas fields. It can be expected that the gas fields will remain developed for industrial purposes for a term of up to 70 years, depending on the amount of gas present, the rate of drilling, the price of gas, and the production rate of the wells.

3.9.3 Special Recreation Management Areas

The basic units of recreational management are either the SRMA or the ERMA. An SRMA is an area with a commitment to provide specific recreational activities and opportunities. These areas usually require a high level of recreational management. An ERMA is an area in which recreation management is one of several management objectives and by default is the remainder of land not covered by SRMAs. These areas may include developed and primitive recreation sites with minimal facilities. The SRMAs in the planning area include (1) Scab Creek, (2) Boulder Lake, and (3) Upper Green River. The SRMAs are summarized below:

- **Scab Creek SRMA.** The Scab Creek SRMA (18,460 acres) is located on the eastern boundary of the planning area, along the lower slopes of the Wind River Range and adjacent to the Bridger Wilderness area. This area provides a wide range of recreational uses, including camping, horseback riding, rock climbing, hunting, and fishing. Facilities such as horse corrals, horse-loading docks, camping areas, road access and trailhead parking areas, toilets, and fire rings are provided outside the WSA. The Scab Creek SRMA is heavily used by the public in the summer and fall. The area is closed to human presence in the winter months as a result of elk feeding activities at the Scab Creek Elk Feedground. The area includes 2 miles of developed trail (Scab Creek Trail) and 4 miles of undeveloped trail. The area is consistently used by the National Outdoor Leadership School to teach rock climbing, wilderness camping, and cross-country skiing.

- **Boulder Lake SRMA.** Boulder Lake SRMA (5,790 acres) encompasses approximately 3 miles of the shoreline of Boulder Lake and the surrounding area. The SRMA is located approximately 8 miles north of the town of Boulder and provides two campgrounds located on the north and south sides of the lake. The north campground consists of picnic tables, grills, a toilet, and an undeveloped boat launch site. The south campground consists of several undesignated campsites, picnic tables, a toilet, and a fully developed boat ramp facility. The area, which is used heavily during the summer and fall, is a popular destination for boaters, fishermen, hunters, and campers. A third campground, called Stokes Crossing, is located on Boulder Creek west of the lake. This campground consists of undesignated campsites, picnic tables, and a toilet.

- **Upper Green River SRMA.** This remote 12-mile stretch of river, which provides fishing access, from shore and by boat, starts south of Black Butte and continues south to the Warren Bridge Campground at US Highway 189/191. Scenery encountered while floating this stretch is characterized as an undeveloped, natural waterway with stunning views of the surrounding mountain ranges. Twelve semideveloped campsites with picnic tables, toilets, and fire pits are provided. Although no developed boat launches exist, small craft are easily taken in or out at a few locations. The Warren Bridge Campground is a fully developed fee camp area providing sanitary service for the SRMA. As a result of increased use in the area over the years, a recreation project plan has been developed to address user needs and human health and safety.

3.10 SOCIOECONOMICS

The planning area is located in western Wyoming in portions of Lincoln and Sublette counties. Activities in the planning area also have the potential to affect Sweetwater County because it serves as an important economic center for several activities, including oil and gas development. Therefore, the socioeconomic study area includes Lincoln and Sublette counties (within the planning area) and Sweetwater County (outside the planning area), as shown in Map 3-7.

3.10.1 Community Characteristics

Like much of Wyoming, the socioeconomic study area is quite rural. All three counties have a rather large land area with a dispersed population, as summarized in Table 3-12. The number of persons per square mile ranges from 1.6 in Sublette County to 3.8 in Sweetwater County, which is below state and national averages.

The largest population centers in the socioeconomic study area are listed in Table 3-13. This table highlights the differences in population growth throughout the area. Many of the largest towns located in the southern part of the area reported small increases in population from July 2000 to July 2006, whereas smaller communities, such as Afton and Pinedale in the northern part of the area, reported different population growth rates with Afton's population slightly decreasing and Pinedale's increasing by more than 31% during the same 6-year period. Public lands dominate this area, with 67% of total land area being administered by federal agencies, including BLM.

Table 3-12. Geographic Characteristics of Study Area (2007)

Geographic Characteristic	Lincoln	Sublette	Sweetwater	Wyoming	United States
Land area (millions of acres)	2.6	3.1	6.7	62.1	2,200
Land area (sq. miles)	4,069	4,883	10,425	97,100	3,537,441
Population (July, 2007 estimate)	16,171	7,925	39,305	522,830	301,621,157
Persons per square mile (2007 estimate)	2.6	1.6	3.8	5.4	85.3

Source Data: Census Bureau State and County Quickfacts.

Table 3-13. Population Centers

County	City	Population				
		Census 1990[1]	Census 2000[2]	July 2000 Estimate[2]	July 2006 Estimate[2]	Percentage Change July 2000 to July 2006
Lincoln	Afton	1,394	1,818	1,848	1,821	–1.5%
	Kemmerer	3,020	2,651	2,649	2,525	–4.7%
Sublette	Pinedale	1,181	1,412	1,407	1,846	31.2%
Sweetwater	Green River	12,711	11,808	11,768	11,933	1.4%
	Rock Springs	19,050	18,708	18,592	19,324	3.9%

[1] Source: U.S. Census Bureau 1990 census.
[2] Source: U.S. Census Bureau, Population Division, Subcounty Population Estimates; July 2008.

3.10.2 Social Development, Culture, and History of Communities

Understanding the social development, culture, and history of an area provides valuable insight into how events or changes to the area may affect the livelihood and quality of life of the residents. Historically, the planning area was developed with sparse populations, rural characteristics, and natural resource-based economies. Many of the communities within the area share similar historical paths. This section is intended to give a general representation of the communities that are within, or in close proximity to, the planning area. These social, cultural, and historical development patterns will help determine how BLM management decisions could affect local communities.

Pinedale

Located at the foot of the Wind River Mountain Range and close to the Bridger Wilderness, Pinedale is the largest community in Sublette County with 1,846 residents in 2006. The first inhabitants of the area were Shoshone, Gros Ventre, Bannock, Sheepeater, and Crow Native American tribes. White explorers, mainly trappers and mountain men, arrived in the early 1800s, drawn to the area by the tales of streams rich with beaver. Later, ranchers and cattlemen began to winter their stock in the area and eventually settled there themselves. Pinedale was platted in 1899 and became the Sublette County seat in 1926. Ranching has historically been an important industry for the area. The tourism industry has played a large part in the economic development of Pinedale, with recreation opportunities that include fishing or boating in the many lakes surrounding Pinedale, snowmobiling in the surrounding mountain ranges, skiing at White Pine Ski Area, hiking in the Wind River Mountains, and wildlife viewing. In the last few years, the level of oil and gas development has considerably increased, making it the dominant industry with timber and grazing declining in the area.

Boulder

Not far from the New Fork River at an elevation of 7,016 feet, the small community of Boulder is located 12 miles south of Pinedale. Traditionally a ranching community, Boulder has a population of 30 (according to the U.S. Census Bureau 2000 census). Increases in oil and gas activity in the area have transformed this community into a town less tied to ranching and more tied to supporting the oil and gas development. The town has a general store, motel, restaurant, gas station, recreational vehicle (RV) park, community center, and volunteer fire department. Outdoor recreation also plays a major role in Boulder. Taking advantage of its location along the Continental Divide Snowmobile Trail and providing services for those riding the Continental Divide Mountain Bike Trail, it is the last populated area with services for many miles until riders cross the Continental Divide of the Rocky Mountains over South Pass in the southern Wind River Mountain Range.

Bondurant

The small community of Bondurant, with a population of 155 (according to the U.S. Census Bureau 2000 census), is nestled in the scenic Hoback River Valley at the base of the Gros Ventre Mountains south of Jackson Hole on US Highway 191. This tiny community is named for B.F. Bondurant, who established his ranch in the Hoback Canyon in 1900 and later built a store and post office. Bondurant is now primarily a ranching and retirement community. It is spread over a wide area, with the post office located several miles from the town proper. Many of the residents are seasonal, coming in the spring and preferring to leave before winter to avoid the heavy snowfalls. Services in Bondurant include a post office, church, elementary school, convenience store, and gas station; however, these buildings are located several miles apart. Bondurant serves as a support town for those venturing into the Gros Ventre Wilderness Area and passing through on their way to Jackson Hole, Grand Teton and Yellowstone National Parks, and Granite Hot Springs. Recreation activities are abundant in and around Bondurant and include fishing, hunting, snowmobiling, horseback riding, and wildlife viewing.

Daniel

The town of Daniel, located in the heart of the Upper Green River Valley, was settled in 1899 and is located 1 mile south of the junction with Highway 191 on Highway 189. Just west of Daniel, at the confluence of Green River and Horse Creek, is one of the original sites of the fur traders and Native Americans rendezvous. Today, it is likely that Daniel supports mainly oil and gas activity, which has increased throughout the area. In 2000, Daniel had 89 residents (according to the U.S. Census Bureau 2000 census). There are few services in the town proper. A convenience store, gas station, and motel facility are located north of town at the junction of the two highways. During severe winter storms, the town of Daniel often becomes a refuge for travelers who are stranded by the closure of Highway 191 north to Jackson and Yellowstone National Park.

Big Piney

Big Piney is the oldest settlement in Sublette County, with a population of 461 people (according to the U.S. Census Bureau estimates 2006 census). The town was named by Dan B. Budd for the Piney Creek that run through town. Budd, along with his partner Hugh McKay, brought a thousand head of cattle from Nevada to the area in 1879. The following year, Budd moved his family to Big Piney, thereby beginning the settlement of this town. Big Piney was called the "Ice Box of the Nation" when it was officially made a weather station in 1930 and reported the coldest year-round average temperature of any place in the nation. Although Big Piney has a tradition of being a rural ranching community, nearby gas fields are the main driver of Big Piney's economy. The Green River and the Wyoming Range mountains are a short distance from this community, adding to the recreation and tourism industry of the area.

Marbleton

Considering that Wyoming towns are few and far between, it is unusual that Big Piney and Marbleton would be only 1 mile apart on Highway 189. The town of Marbleton, incorporated in 1914, was the dream of Charles P. Budd, the eldest son of Dan Budd, who founded Big Piney. In the early days, the site of Big Piney had many drainage problems. Consequently, Charles Budd tried to move the town to a higher but more level location to take advantage of better building sites. Charles established Marbleton in late 1913, but it never replaced Big Piney. Marbleton started out as Big Piney's rival, each vying to be the major town site in this area. They have separate post offices and town governments, and any attempts to combine the two towns have been unsuccessful. However, the towns cooperate with one another and have a combined fire department. In many ways, both towns have grown and prospered. Industries supporting Marbleton today include ranching, oil and gas extraction, and tourism, and a small general aviation airport serves both Marbleton and Big Piney. Recent gas development has been a significant driver of both Big Piney and Marbleton's economies. Marbleton has a population of 862, according to the 2006 census estimates.

LaBarge

LaBarge is located in the northern end of Lincoln County just across the Lincoln-Sublette County border. Although it is not in the Sublette County, county citizens share very close ties with this town. LaBarge is in the same school district as Big Piney and Marbleton. It has its own elementary school, but the older students are bused 20 miles to the Big Piney Middle and High Schools. LaBarge's economy depends on the energy resource development in both Sublette and Lincoln counties, as do the economies many of the neighboring communities. In 2006, LaBarge had a population of approximately 440 residents.

Cora

The Wind River Mountain Range provides a beautiful backdrop for Cora, which has a population of 76 (according to the U.S. Census Bureau 2000 census). Located 10 miles northwest of Pinedale, Cora,

primarily a ranching community, is along the New Fork River on the way to Green River Lakes and New Fork Lakes. At one time, Cora boasted a saloon, blacksmith shop, dance hall, and newspaper. Today, the town of Cora is made up of a dispersed population with only a tiny post office, a pay telephone, and no other services.

Rock Springs

Conveniently located right off Interstate 80, Rock Springs is situated in southwestern Wyoming. Formed by the railroad and coal companies, Rock Springs offers a variety of recreational opportunities for visitors and residents, including river activities, camping, hunting, wildlife viewing, and OHV riding. The Greater Sand Dunes, which can be accessed a few miles north of Rock Springs, is the largest such dunes feature in North America. Rock Springs was established in 1888 as a mining town; the natural resources around the area are the driving force behind its economy. As an energy and transportation center, Rock Springs is the service center for the booming gas development in southwestern Wyoming. Like most other mining and energy towns, Rock Springs has historically experienced booms and busts. In 2006, Rock Springs had a population of approximately 19,324 people.

Green River

Green River is located 14 miles west of Rock Springs on Interstate 80. It is situated on the Green River at about 6,200 feet in elevation. In 2006, there were approximately 11,933 people living in the City of Green River. Green River is the county seat of Sweetwater County and is the second largest city after Rock Springs. Unlike Rock Springs, which grew up as a coal-mining town, Green River developed through its relationship with the Union Pacific Railroad. Incorporated in 1868, in what was then the Dakota Territory, and named for the swift flowing greenish river that courses through town, the City of Green River has a long and varied history. Native Americans, indigenous animals (pronghorns, buffalo, deer, etc.), mountain men, pioneers, ranchers, railroad people, and miners have all left their footprints and their legacies in Green River. It was from Green River that John Wesley Powell started his famous explorations of the Green River, the Colorado River, and the Grand Canyon in the late 1800s. Today, the railroad still has a major presence. Mining, particularly of trona, is the major industry in the area. There are also many recreational amenities located in Green River, including a water park, golf course, walkway, and cultural attractions, and the Green River and Flaming Gorge Reservoir offer a wide variety of fishing opportunities.

Afton

Located approximately 60 miles south of Jackson in Lincoln County, Afton comprises approximately 1,821 people. Afton is located in Star Valley lying between the peaks of the Salt River Range in western Wyoming and the Webster Range of eastern Idaho. Afton was founded by Mormon settlers along the Lander Cutoff of the Oregon Trail. The Lander Trail, which passes near Afton, was the first government-built wagon road in the West. Wagon trains used the Lander Trail as a cutoff from the Oregon Trail to the California gold fields. A person can drive to many points along the trail and walk through portions of the trail rutted by wagons and see tree carvings left by early pioneers. Today the trail is listed on the NRHP. Gold was discovered near Afton on Mt. Pisgah (now Caribou Mountain) in 1870 by Jesse Fairchilds, or "Cariboo Jack," an itinerant miner who gained his name in the Cariboo Mining District of British Columbia. A typical western gold rush followed. About $1 million worth of gold was taken from the area, mainly by placer methods. In addition, Butch Cassidy and his band of outlaws had a camp in Star Valley. Cassidy's gang robbed the Montpelier Bank of $16,500 on August 13, 1896, and escaped up Montpelier Canyon. Today, there are significant recreational opportunities in Afton, with access to hiking and horseback riding trails, mountain lakes and streams for fishing, and many miles of forest roads and highways for sightseeing.

Kemmerer

Kemmerer is a small town, home to approximately 2,525 people in 2006, located just south of the planning area in Lincoln County. It is situated just east of the Fossil Butte National Monument, surrounded by high desert and the Rocky Mountains. Explorer John C. Fremont first chanced upon coal here in 1843, but it was not until 1881 that the Union Pacific opened the first underground coalmine. Patrick J. Quealy and his partner, Mahlon S. Kemmerer, established the Kemmerer Coal Company. In 1950, the operation moved aboveground, and the Kemmerer mine became the Pittsburg & Midway Coal Company, now a subsidiary of Chevron. Located 6 miles south of Kemmerer, the mine is the world's largest open pit coalmine. James Cash "JC" Penney founded his retail chain upon moving to Kemmerer in 1902 to open a dry goods store for the booming mining town. The original J.C. Penney store is still a thriving retail outlet. Today, Kemmerer and the surrounding area offer plentiful recreational opportunities, including fly fishing on the Green River, Hams Fork, Lake Viva Naughton, and Fontenelle Reservoir; big game hunting; a golf course; and many historical sites. The economy of Kemmerer is also being driven by the oil and gas boom occurring in southwestern Wyoming.

3.10.3 Economic Characteristics

This section focuses on trends associated with certain economic characteristics in the socioeconomic study area, including not only changes in the labor force and unemployment but also trends in employment and earnings by industry.

Labor Force and Unemployment

Changes in the labor force and unemployment can provide information on the health of the local economy. As a whole, unemployment in the socioeconomic study area has been higher than unemployment for the State of Wyoming during the 1990s. For the past 6 years, unemployment rates in the study area have continually decreased and were lower than the state and national averages since 2003. The decreases in the unemployment rate in the socioeconomic study area correspond with the oil and gas industry boom.

Changes in the civilian labor force are summarized for each county and Wyoming in Table 3-14. The civilian labor force is defined as all persons over age 16 in the civilian noninstitutional population who either had a job or were seeking a job in the past 12 months. Overall, the socioeconomic study area realized higher growth in the civilian labor force than did the state, with Sublette County realizing a growth rate significantly higher than the state average of 121% over the 11-year period.

Table 3-14. Change in Civilian Labor Force 1996–2007

	1996	2007	Percentage Change 1996–2007
Lincoln	6,390	8,844	38%
Sublette	3,040	6,722	121%
Sweetwater	21,010	23,908	14%
Study Area	30,440	39,474	30%
Wyoming	254,717	287,743	13%

Source: Bureau of Labor Statistics

Employment and Earnings by Industry

Employment and earnings trends from 1990 to 2006 were examined using the latest available data obtained from the Bureau of Economic Analysis (BEA) Regional Economic Information System (REIS)

(May 2008). BEA data included total annual employment and earnings for each county, Wyoming, and the United States for 1990 to 2000 and 2001 to 2006 so that employment and earnings trends and 2006 employment and earnings snapshots by industry could be examined. Total annual employment includes full- and part-time jobs; therefore, individuals with more than one job are counted twice. The employment estimates include those individuals who are employed by businesses and public entities as well as those who are self-employed.

In 2001, the BEA switched from the Standard Industrial Classification (SIC) to the North American Industry Classification System (NAICS) to better capture new industries that did not exist when the SIC classifications were created. The employment and earnings trends by industry have been separated to avoid mixing the SIC and NAICS classifications. The trends for 1990 to 2000 use the SIC industry classification, and trends from 2001 to 2006 use the NAICS classification. BEA estimates annual employment and earnings for counties nationwide. BEA will not show confidential information such as the total employment for an industry sector that has few companies. BEA REIS data from 2001 to 2006 show undisclosed data for many industry sectors.[2]

Total employment in the three-county socioeconomic study area increased by 41% during the 17-year period from 1990 to 2006, compared with slightly slower growth for the State of Wyoming (38%) over the same period. Growth was driven by substantial growth in employment in Sublette County, 111% over the 17-year period, and 53% growth between 2000 and 2006. Between 2000 and 2006, all counties in the study area experienced employment growth at rates higher than those of the state. Between 1990 and 2006, Sweetwater and Lincoln counties were growing at rates below that of the State of Wyoming. Table 3-15 summarizes these trends.

Table 3-15. Employment Trends in Wyoming and the Socioeconomic Study Area, 1990–2006

Location	1990	2000	2001	2006	Percentage Change 1990–2000	Percentage Change 2001–2006
Wyoming	272,431	328,036	333,030	376,249	20%	13%
Lincoln	6,868	8,114	8,434	10,077	18%	19%
Sublette	3,077	3,977	4,251	6,488	29%	53%
Sweetwater	22,840	24,249	24,493	29,811	6%	22%
Study Area	32,785	36,340	37,178	46,376	11%	25%

Source: Total Full-time Employment, Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce, SIC CA25 (1990 and 2000), NAICS CA25N (2001 and 2006).

Study area employment by industry for 1990 through 2000 and 2001 through 2006 is summarized in Figures 3-29 and 3-30, respectively. Trends are not shown for industry sectors with undisclosed data. Employment figures are summarized in Tables 3-16 and 3-17. Wholesale and retail trade, services, and government compose the largest percentage of total employment for the socioeconomic study area during the 10-year period from 1990 to 2000. Since 2001, nearly all industries have shown slight increases in employment. Mining was the second largest source of employment in 1990, but began decreasing in 1994, becoming the fourth largest industry employer by 2000. From 2001 to 2006, mining employment has shown a 62% increase (4,907 to 7,936 employees).

[2] To fill these data gaps, U.S. Census Bureau County Business Patterns data are used, when available, to fill the data gap directly or indirectly by assuming a midpoint from a range of values. For example, the County Business Patterns reported a range of 0–19 employees for the total employment for forestry, fishing, hunting, and agriculture support industry in Sweetwater County in 2004. To fill the data gap for the forestry, fishing, hunting, and agriculture support industry total employment, the midpoint value of 10 would be assumed.

Table 3-16 and Table 3-17 show employment trends by industry between 2001 and 2006 for each county, the study area, and Wyoming. Because of industry disclosure restrictions, many gaps exist for a number of industries in BEA REIS data. In light of these data gaps, supplemental tables for selected industries are shown below (see Table 3-18 and Table 3-19).

Overall, the study area has experienced a 25% employment growth between 2001 and 2006, compared with 13% growth in the State of Wyoming as shown in Table 3-16. This table shows that the industries in the study area with the largest employment increases from 2001 to 2006 are construction, 53%, and transportation and warehousing, 50%. Real estate also showed large increases in employment, 36%. By comparison, the State of Wyoming showed the greatest employment increases in mining, 42%; educational services, 30%; and real estate, 30%. These statistics indicate economic activity attributable to increased residential and commercial development in the study area and Wyoming. Accommodation and food employment showed healthy growth during the period from 2001 to 2006 for the study area and Wyoming as a whole. This growth may reflect tourist and, more likely, traveling business presence in the area.

Few industries show declines in employment from 2001 to 2006. Sublette County showed a decline in art, entertainment, and recreational employment of 13% compared with a decline of 4% for the State of Wyoming over the same period. Both Sweetwater and Lincoln counties show declines in manufacturing (11 and 18%, respectively), compared with a 3% increase in this industry's employment for the State of Wyoming.

Table 3-8 shows trends of increasing mining employment in all counties, the study area, and Wyoming. Change is most significant for Sublette County, with a 164% increase in mining employment between 2000 and 2006. It is also likely that employees are commuting to the economic study area to support the oil and gas boom but report their employment and earnings where they live. Therefore, these employment figures may not represent these nonresidential employees in the area. If this is the case, many of the costs created by this temporary influx of workers are being borne by the residents without the usual offsetting tax and spending revenues created by workers permanently relocating to the region.

Counties in the socioeconomic study area are typical of many rural areas throughout the West and rely more heavily on traditional natural resource-based industries, such as mining and agriculture. In 2006, mining jobs, including oil and gas operations, accounted for 17.1% of total employment in the socioeconomic study area, 10% higher than the state average of 7.8%. According to BEA, mining industries employed the second largest percentage of the total employment in the study area, second only to services in 2006. Government employment represents the third largest employer in the study area in the same year.

Table 3-16. Employment Trends by Industry in Wyoming and the Socioeconomic Study Area, 2001–2006

Industry Sector	Study Area			Wyoming		
	2001	2006	Percentage Change 2001–2006	2001	2006	Percentage Change 2001–2006
Total	**37,178**	**46,376**	**25%**	**333,030**	**376,249**	**13%**
Agricultural services	NA	243	NA	2,821	2,695	-4%
Mining	NA	7,936	NA	20,709	29,359	42%
Utilities	NA	NA	NA	NA	2,390	NA
Construction	3,510	5,365	53%	27,226	33,986	25%
Manufacturing	NA	1,701	NA	11,468	11,791	3%
Wholesale trade	NA	NA	NA	7,814	9,338	20%
Retail trade	4,379	4,600	5%	39,550	41,074	4%
Transportation and warehouse	1,412	2,124	50%	NA	13,925	NA
Information	434	504	16%	NA	5,037	NA
Finance and insurance	845	1,028	22%	10,218	11,858	16%
Real estate & rental	1,174	1,457	24%	11,703	15,219	30%
Professional services	1,084	1,477	36%	14,169	16,757	18%
Management of companies	NA	NA	NA	938	1,045	11%
Admin and waste services	NA	NA	NA	11,380	11,948	5%
Educational services	NA	NA	NA	2,394	3,117	30%
Health and social care	NA	NA	NA	23,811	26,714	12%
Art, entertainment, and recreation	503	NA	NA	6,895	6,602	-4%
Accommodation and food	3,073	3,638	18%	28,605	32,540	14%
Other services	1,649	2,359	43%	NA	20,363	NA
Government	6,468	6,895	7%	65,361	68,521	5%

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Table 3-17. Industry Employment by County from 2001–2006

Industry Employment	Sweetwater			Lincoln			Sublette		
	2001	2006	Percent-age Change 2001–2006	2001	2006	Percent Change 2001–2006	2001	2006	Percent-age Change 2001–2006
Total	**24,493**	**29,811**	**22%**	**8434**	**10077**	**19%**	**4251**	**6488**	**53%**
Ag. services	NA	59	NA	87	93	7%	78	91	17%
Mining	NA	6,051	NA	436	744	71%	432	1141	164%
Utilities	NA	NA	NA	NA	NA	NA	NA	41	NA
Construction	1,811	2,695	49%	1227	1687	37%	472	983	108%
Manufacturing	1,426	1,275	-11%	403	330	-18%	NA	96	NA
Wholesale trade	NA	NA	NA	NA	NA	NA	NA	42	NA
Retail trade	2,928	3,064	5%	1009	974	-3%	442	562	27%
Trans and warehouse	1,111	1,680	51%	220	268	22%	81	176	117%
Information	258	254	-2%	125	178	42%	51	72	41%
Finance and insurance	540	608	13%	224	291	30%	81	129	59%
Real estate and rental	675	874	29%	324	373	15%	175	210	20%
Professional services	616	824	34%	231	347	50%	237	306	29%
Management of companies	90	73	-19%	NA	NA	NA	NA	NA	NA
Admin and waste services	799	922	15%	NA	NA	NA	NA	184	NA
Educational services	91	155	70%	21	45	114%	NA	NA	NA
Health and social care	1,196	1,286	8%	NA	444	NA	NA	NA	NA
Art, entertainment, and recreation	284	NA	NA	124	138	11%	95	83	-13%
Accommodation and food	2,102	2,417	15%	585	643	10%	386	578	50%
Other services	1,062	1,542	45%	376	529	41%	211	288	36%
Government	4,210	4,282	2%	1556	1738	12%	702	875	25%

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce

Table 3-18. Mining Employment 2001–2006

Region	2001	2002	2003	2004	2005	2006
Wyoming	20,709	20,228	21,390	23,011	25,601	29,359
Lincoln	436	586	648	672	681	744
Sublette	432	485	667	749	844	1,141
Sweetwater	NA	NA	NA	NA	5,231	6,051
Study Area	NA	NA	NA	NA	6,756	7,936

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Table 3-19. Arts and Entertainment Employment 2001–2006

Region	2001	2002	2003	2004	2005	2006
Wyoming	6,895	6,242	6,212	6,288	6,372	6,602
Lincoln	124	138	127	127	140	138
Sublette	95	120	123	109	79	83
Sweetwater	284	318	308	293	NA	NA
Study Area	503	576	558	529	NA	NA

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Total earnings by industry for counties in the study area, Wyoming, and the United States for 1990 through 2006 were also obtained from BEA. As with the employment data, data gaps exist in earnings data. Figures 3-31 and 3-32 provide a summary of gross earnings by industry for the study area for 1990 through 2000 and 2001 through 2006. Table 3-21 and Table 3-22 show nominal earnings, and Tables 3-24 and 3-25 show these figures adjusted for inflation. Supplemental data tables are also shown for selected industries with undisclosed data. Data in nominal and real terms are shown, and inflation indices for southwestern Wyoming and Wyoming are shown in Table 3-23.

According to BEA, the socioeconomic study area total gross earnings for all industries (private non-farm, farm, and government) increased by 39% between 1990 and 2006 compared with 42% for the State of Wyoming. Slightly slower growth over the 17-year period is attributable to declines in earnings from 1990 to 2000 that were particularly severe in Lincoln and Sweetwater counties. More recent trends in earnings (2001 to 2006) in the socioeconomic study area show higher percentage growth (34%) than state earnings (20%), in large part because of very fast growth in Sublette Country, where earnings more than doubled from 2001 to 2006. Table 3-20 shows these trends.

Table 3-20. Total Gross Earnings Trends in Wyoming and the Socioeconomic Study Area, 1990–2006 (Thousands, Real 2006$)

Location	1990	2000	2001	2006	Percentage Change 1990–2000	Percentage Change 2001–2006
Wyoming	$ 10,695,609	$ 12,190,566	$ 12,662,556	$ 15,169,542	14%	20%
Lincoln	$ 251,276	$ 254,021	$ 275,041	$ 340,631	1%	24%
Sublette	$ 94,585	$ 116,093	$ 134,451	$ 273,446	23%	103%
Sweetwater	$ 1,243,252	$ 1,236,463	$ 1,239,322	$ 1,588,325	-1%	28%
Study Area	$ 1,589,113	$ 1,606,577	$ 1,648,814	$ 2,202,402	1%	34%

Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce, (1990 and 2000) SIC Table CA25, (2001 and 2006) NAICS CA25N; study area counties earnings were inflated with the southwestern Wyoming inflation factors, which are shown in Table 3-23.

In 2006, mining comprises the highest percentage of total earnings for the socioeconomic study area, representing one-third of all earnings reported (see Figure 3-32). Construction and government earnings were also significantly represented in total earnings for the study area, comprising 11% and 14%, respectively. These percentages were fairly consistent with state earnings; mining activity earnings showed a high percentage of total earnings for the State of Wyoming (19%), although government services showed the highest percentage for the state (22%) and construction was slightly less of the total earnings (9%).

Table 3-25 shows declines in the manufacturing sector for Sweetwater and Lincoln counties (11% and 34% declines, respectively), while Sublette County shows a 20% increase in manufacturing earnings from 2003 to 2006 where data are disclosed. State-level manufacturing showed a 4% increase over the same period. County-level arts and entertainment earnings appear to have generally declined for the period from 2001 to 2006, which is consistent with a 22% decline at the state level as is reflected in Table 3-24.

The mining sector (which includes oil and gas) dominated total earnings throughout the 11-year period from 1990 to 2000, peaking in industry earnings in 1994. In 1990, mining earnings were 38% of total earnings in the study area, while in 2000, mining earnings were 30% of total earnings in the study area. Because of the undisclosed data, continuous data through 2006 for the study area are not available. However, the data available for the study suggest high growth in the mining sector from 2001 through 2006, reflecting the recent increase in oil and gas activity in the area. In 2006, mining earnings were 33% of total earnings in the study area. Table 3-26 summarizes data for these recent trends.

Table 3-21. Earning Trends by Industry in Wyoming and the Socioeconomic Study Area, 2001–2006 (Thousands, Nominal Dollars)

Industry Sector	Study Area			Wyoming		
	2001	2006	Percent-age Change 2001–2006	2001	2006	Percent-age Change 2001–2006
Total	**$1,309,460**	**$2,202,402**	**68%**	**$10,370,644**	**$15,169,542**	**46%**
Agriculture services	NA	$3,347	NA	$52,691	$41,923	-20%
Mining	NA	$735,676	NA	$1,496,432	$2,863,028	91%
Utilities	NA	NA	NA	NA	$244,991	NA
Construction	$128,005	$249,583	95%	$938,955	$1,394,773	49%
Manufacturing	NA	$137,810	NA	$556,526	$706,777	27%
Wholesale trade	NA	NA	NA	$344,484	$536,233	56%
Retail trade	$78,684	$108,442	38%	$776,957	$941,347	21%
Transportation and warehouse	$69,611	$126,258	81%	NA	$781,795	NA
Information	$10,853	$15,361	42%	NA	$187,337	NA
Finance and insurance	$26,358	$33,953	29%	$350,449	$440,975	26%
Real estate and rental	$34,833	$52,718	5%	$268,214	$416,445	55%
Professional services	$38,723	$62,192	61%	$508,123	$686,287	35%
Management of companies	NA	NA	NA	$38,172	$91,300	139%
Admin and waste services	NA	NA	NA	$214,828	$250,770	17%
Educational services	NA	NA	NA	$34,368	$53,541	56%

Industry Sector	Study Area			Wyoming		
	2001	2006	Percentage Change 2001–2006	2001	2006	Percentage Change 2001–2006
Health and social care	NA	NA	NA	$719,721	$984,233	37%
Art, entertainment, and recreation	$8,439	NA	NA	$131,974	$125,908	-5%
Accommodation and food	$37,842	$62,600	65%	$377,030	$639,524	70%
Other services	$26,819	$60,986	127%	NA	$400,792	NA
Government	$218,612	$314,085	44%	$2,397,089	$3,381,563	41%

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce

Table 3-22. Industry Earnings by County, 2001–2006 (Thousands, Nominal Dollars)

Earnings by Industry	Sweetwater			Lincoln			Sublette		
	2001	2006	Percent-age Change 2001-2006	2001	2006	Percent-age Change 2001–2006	2001	2006	Percent-age Change 20012006
Total	**$984,248**	**$1,588,325**	**61%**	**$218,433**	**$340,631**	**56%**	**$106,779**	**$273,446**	**156%**
Agriculture services	**NA**	**$1,084**	**NA**	**$1,157**	**$1,141**	**-1%**	**$788**	**$1,122**	**42%**
Mining	NA	$572,353	NA	$29,898	$66,236	122%	$22,820	$97,087	325%
Utilities	NA	NA	NA	NA	NA	NA	NA	$3,960	NA
Construction	$72,985	$141,143	93%	$41,152	$66,031	60%	$13,868	$42,409	206%
Manufacturing	$110,430	$124,006	12%	$12,879	$10,686	-17%	NA	$3,118	NA
Wholesale trade	NA	NA	NA	NA	NA	NA	NA	$1,889	NA
Retail trade	$56,203	$78,025	39%	$14,026	$17,713	26%	$8,455	$12,704	50%
Trans and warehouse	$56,599	$105,341	86%	$10,030	$12,597	26%	$2,982	$8,320	179%
Information	$6,334	$7,447	18%	$3,387	$5,824	72%	$1,132	$2,090	85%
Finance and insurance	$16,917	$22,186	31%	$7,237	$6,165	-15%	$2,204	$5,602	154%
Real estate and rental	$27,910	$37,360	34%	$4,545	$10,138	123%	$2,378	$5,220	120%
Professional services	$24,655	$39,725	61%	$5,353	$9,392	75%	$8,715	$13,075	50%
Management of companies	$4,613	$3,753	-19%	NA	NA	NA	NA	$592	NA
Admin and waste services	$15,731	$28,243	80%	NA	NA	NA	NA	$4,098	NA
Educational services	$769	$1,766	130%	NA	$172	NA	NA	NA	NA
Health and social care	$32,770	$42,673	30%	NA	$8,404	NA	NA	NA	NA

Earnings by Industry	Sweetwater			Lincoln			Sublette		
	2001	2006	Percent-age Change 2001-2006	2001	2006	Percent-age Change 2001–2006	2001	2006	Percent-age Change 20012006
Art, entertainment, and recreation	$3,453	NA	NA	$2,607	$3,027	16%	$2,379	$1,841	-23%
Accommodation and food	$27,564	$42,621	55%	$5,227	$6,229	19%	$5,051	$13,750	172%
Other services	$19,683	$50,688	158%	$4,702	$6,482	38%	$2,434	$3,816	57%
Government	$145,276	$192,494	33%	$49,088	$75,231	53%	$24,248	$46,360	91%

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Table 3-23. Southwestern Wyoming and Wyoming Inflation Rates, Cost of Living Index, and Inflation Factors

Year	Southwestern Wyoming 2nd Quarter Inflation Rate	SW Wyoming Rate Adjustment	Southwestern Wyoming Inflation Factor (2nd Q)	Wyoming Inflation Factor (2nd Q)
1990	3.80	1.038	1.841	1.808
1991	5.40	1.054	1.747	1.736
1992	3.90	1.039	1.681	1.683
1993	2.20	1.022	1.645	1.629
1994	4.10	1.041	1.580	1.559
1995	3.60	1.036	1.525	1.489
1996	5.30	1.053	1.448	1.422
1997	2.80	1.028	1.409	1.383
1998	2.60	1.026	1.373	1.363
1999	3.40	1.034	1.328	1.328
2000	2.30	1.023	1.298	1.273
2001	3.10	1.031	1.259	1.221
2002	1.40	1.014	1.242	1.191
2003	3.50	1.035	1.200	1.158
2004	4.60	1.046	1.147	1.104
2005	6.60	1.066	1.076	1.056
2006	7.60	1.076	1	1

Source: Wyoming Economic Analysis Department, Cost of Living Inflation Rates.

Table 3-24. Earning Trends by Industry in Wyoming and the Socioeconomic Study Area, 2001–2006 (Thousands, Real 2006$)

Industry Sector	Study Area			Wyoming		
	2001	2006	Percentage Change 2001–2006	2001	2006	Percentage Change 2001–2006
Total	**$1,648,814**	**$2,202,402**	**34%**	**$12,662,556**	**$15,169,542**	**20%**
Agriculture services	NA	$3,347	NA	$64,336	$41,923	-35%
Mining	NA	$735,676	NA	$1,827,143	$2,863,028	57%
Utilities	NA	NA	NA	NA	$244,991	NA
Construction	$161,178	$249,583	55%	$1,146,464	$1,394,773	22%
Manufacturing	NA	$137,810	NA	$679,518	$706,777	4%
Wholesale trade	NA	NA	NA	$420,615	$536,233	27%
Retail trade	$99,075	$108,442	9%	$948,664	$941,347	-1%
Transportation and warehouse	$87,651	$126,258	44%	NA	$781,795	NA

Industry Sector	Study Area			Wyoming		
	2001	2006	Percentage Change 2001–2006	2001	2006	Percentage Change 2001–2006
Information	$13,666	$15,361	12%	NA	$187,337	NA
Finance and insurance	$33,189	$33,953	2%	$427,898	$440,975	3%
Real estate and rental	$43,860	$52,718	20%	$327,489	$416,445	27%
Professional services	$48,758	$62,192	28%	$620,418	$686,287	11%
Management of companies	NA	NA	NA	$46,608	$91,300	96%
Admin and waste services	NA	NA	NA	$262,305	$250,770	-4%
Educational services	NA	NA	NA	$41,963	$53,541	28%
Health and social care	NA	NA	NA	$878,779	$984,233	12%
Art, entertainment, and recreation	$10,626	NA	NA	$161,140	$125,908	-22%
Accommodation and food	$47,649	$62,600	31%	$460,354	$639,524	39%
Other services	$33,769	$60,986	81%	NA	$400,792	NA
Government	$275,267	$314,085	14%	$2,926,846	$3,381,563	16%

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Table 3-25. Industry Earnings by County, 2001–2006 (Thousands, Real 2006$)

Earnings by Industry	Sweetwater			Lincoln			Sublette		
	2001	2006	Percentage Change 2001–2006	2001	2006	Percentage Change 2001–2006	2001	2006	Percentage Change 2001–2006
Total	**$1,239,322**	**$1,588,325**	**28%**	**$275,041**	**$340,631**	**24%**	**$134,451**	**$273,446**	**103%**
Agriculture services	NA	$1,084	NA	$1,457	$1,141	-22%	$992	$1,122	13%
Mining	NA	$572,353	NA	$37,646	$66,236	76%	$28,734	$97,087	238%
Utilities	NA	NA	NA	NA	NA	NA	NA	$3,960	NA
Construction	$91,899	$141,143	54%	$51,817	$66,031	27%	$17,462	$42,409	143%
Manufacturing	$139,049	$124,006	-11%	$16,217	$10,686	-34%	NA	$3,118	NA
Wholesale trade	NA	NA	NA	NA	NA	NA	NA	$1,889	NA
Retail trade	$70,768	$78,025	10%	$17,661	$17,713	0%	$10,646	$12,704	19%
Trans and warehouse	$71,267	$105,341	48%	$12,629	$12,597	0%	$3,755	$8,320	122%
Information	$7,975	$7,447	-7%	$4,265	$5,824	37%	$1,425	$2,090	47%
Finance and insurance	$21,301	$22,186	4%	$9,113	$6,165	-32%	$2,775	$5,602	102%
Real estate and rental	$35,143	$37,360	6%	$5,723	$10,138	77%	$2,994	$5,220	74%
Professional services	$31,044	$39,725	28%	$6,740	$9,392	39%	$10,974	$13,075	19%
Management of companies	$5,808	$3,753	-35%	NA	NA	NA	NA	$592	NA
Admin and waste services	$19,808	$28,243	43%	NA	NA	NA	NA	$4,098	NA
Educational services	$968	$1,766	82%	NA	$172	NA	NA	NA	NA
Health and social care	$41,263	$42,673	3%	NA	$8,404	NA	NA	NA	NA
Art, entertainment, and recreation	$4,348	NA	NA	$3,283	$3,027	-8%	$2,996	$1,841	-39%
Accommodation and food	$34,707	$42,621	23%	$6,582	$6,229	-5%	$6,360	$13,750	116%

Earnings by Industry	Sweetwater			Lincoln			Sublette		
	2001	2006	Percent-age Change 2001–2006	2001	2006	Percent-age Change 2001–2006	2001	2006	Percent-age Change 2001–2006
Other services	$24,784	$50,688	105%	$5,921	$6,482	9%	$3,065	$3,816	25%
Government	$182,925	$192,494	5%	$61,809	$75,231	22%	$30,532	$46,360	52%

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce

Table 3-26. Mining Earnings, 2001–2006 (Thousands, Real 2006$)

Region	2001	2002	2003	2004	2005	2006
Wyoming	$1,827,143	$1,813,811	$1,932,758	$2,115,126	$2,378,758	$2,863,028
Lincoln	$37,646	$53,351	$59,150	$65,975	$64,674	$66,236
Sublette	$28,734	$36,355	$47,281	$57,143	$70,581	$97,087
Sweetwater	NA	NA	NA	NA	$500,809	$572,353
Study Area	NA	NA	NA	NA	$636,064	$735,676

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Table 3-27. Arts and Entertainment Earnings, 2001–2006 (Thousands, Real 2006$)

Region	2001	2002	2003	2004	2005	2006
Wyoming	$161,140	$161,083	$159,102	$150,341	$126,939	$125,908
Lincoln	$3,283	$4,008	$3,653	$3,751	$3,448	$3,027
Sublette	$2,996	$3,863	$3,840	$3,236	$1,977	$1,841
Sweetwater	$4,348	$4,816	$4,562	$4,015	NA	NA
Study Area	$10,626	$12,687	$12,055	$11,001	NA	NA

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Table 3-28. Manufacturing Earnings, 2001–2006 (Thousands, Real 2006$)

Region	2001	2002	2003	2004	2005	2006
Wyoming	$679,518	NA	$599,200	$650,821	$689,539	$706,777
Lincoln	$16,217	$11,132	$11,723	$12,928	$12,427	$10,686
Sublette	NA	NA	NA	$2,589	$3,001	$3,118
Sweetwater	$139,049	$139,659	$125,718	$125,623	$126,053	$124,006
Study Area	NA	NA	NA	$141,140	$141,481	$137,810

Data were not disclosed (NA) for several other industries.
Source: Regional Economic Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Average Earnings per Job

Important insights can also be gained by examining trends in average earnings per job. For the socioeconomic study area, the average real earnings per job were estimated in inflation-adjusted dollars (2006$) from 2001 to 2006 with the southwestern Wyoming Cost Of Living Index (see Table 3-23 in previous section). Average earnings for Wyoming have risen 29% over the 5-year period while across the study area they have risen 35%, driven primarily by the Sublette County average earnings rising by 47% over the same 5-year period. Average earnings are higher in Sublette and Sweetwater counties, driven by the gas development and production occurring in these areas. Lincoln County's average earnings are below the state's averages.

Table 3-29. Average Earnings Across the Study Area and in Wyoming (2006$)

Location	2001	2002	2003	2004	2005	2006
Lincoln	$33,085	$33,938	$37,056	$36,193	$34,553	$33,951
Sublette	$32,265	$33,786	$36,985	$37,841	$40,602	$42,911
Sweetwater	$50,629	$51,573	$51,890	$52,222	$52,695	$53,236
Study Area	$44,549	$45,884	$48,820	$51,242	$55,054	$59,930
Wyoming	$38,022	$38,190	$38,613	$38,929	$39,290	$40,318

Source: BEA, REIS; study area data inflated with southwestern Wyoming inflation factors; Wyoming data inflated with Wyoming inflation factors.

Table 3-30 summarizes the average earnings for a number of industries in the three-county study area, inflated to 2006 dollars. The most important industry for this area with regard to average real earnings was mining, which is primarily oil and gas employment in this area. Average earnings per job for this industry were $92,701 in 2007. Other higher paying jobs in the area are manufacturing ($81,017), transportation and warehousing ($59,444) and construction ($46,521). In 2006, industries with lower average earnings in the study area include agricultural services ($13,774), retail and wholesale trade ($23,574), and accommodations and food services (23,730). Because of significant inflation in the past few years, a considerable number of industries have experienced decreases in real earning per worker.

Table 3-30. Average Real Earnings by Industry Across the Study Area (2006$)

Industry	2001	2002	2003	2004	2005	2006
Construction	$45,920	$44,494	$50,391	$45,304	$43,796	$46,521
Transportation and warehousing	$62,076	$54,261	$56,290	$57,901	$57,395	$59,444
Information	$31,488	$32,851	$31,072	$32,864	$31,344	$30,478
Finance, Insurance, and Real Estate	$34,123	$34,620	$32,130	$32,662	$33,902	$29,540
Accommodations and Food Services	$20,530	$20,488	$20,373	$20,513	$22,208	$23,730
Mining	NA	NA	NA	NA	$94,148	$92,701

Industry	2001	2002	2003	2004	2005	2006
Retail and Wholesale Trade	$22,625	$22,621	$22,387	$23,270	$23,430	$23,574
Government	$42,558	$44,443	$45,051	$45,805	$45,697	$45,553
Professional and Technical Services	$44,980	$46,256	$44,666	$42,058	$44,049	$42,107
Manufacturing	NA	NA	NA	$84,922	$83,273	$81,017
Agricultural Services	NA	NA	NA	NA	$13,951	$13,774

Source: BEA REIS; inflated with the southwestern Wyoming inflation factors, State of Wyoming Department of Economic Analysis.

Economic Base Analysis

An area's economic base comprises industries that are primarily responsible for bringing outside income into the local economy. Typically, these industries export their goods and services outside the region and, in turn, support ancillary industries such as retail trade, housing construction, and personal services. The location of important industries in certain areas has traditionally been tied to factors such as natural resource base, cost factors (transportation and labor), and existing transportation infrastructure. However, technology has affected these location factors.

To identify specialization in the major industries of the study area economy, location quotients were calculated for nine major industries as listed in Table 3-31. A location quotient was calculated for both employment and income that compares each industry's share of total local employment or income with the industry's state or national share. Generally, this quotient yields a value between 0 and 2; 1.0 indicates an equal share percentage between the local and state or national economies. Location quotients greater than 2 indicate a strong industry concentration, and those less than 0.50 indicate a weak concentration. Table 3-31 summarizes the magnitude of concentration of industries in the socioeconomic study area relative to either the State of Wyoming or the United States.

Table 3-31 indicates the three-county study area generally mirrors the state's economy as a whole. However, both the services and farm and agriculture services industries' earnings for the study area show a weaker concentration compared with those earnings for the state. When compared with the national economy, mining shows an extremely high concentration in both employment and earnings in the study area. This is true for the earnings in the transportation and utilities and manufacturing sectors as well. Alternatively, earnings for services and farm and agricultural services industries for the study area demonstrate weaker concentrations compared with the national economy.

Table 3-31. Location Quotients, 2004

Industry	Employment		Earnings	
	Location Quotient (Study Area/Wyoming)	Location Quotient (Study Area/United States)	Location Quotient (Study Area/Wyoming)	Location Quotient (Study Area/United States)
Farm and agriculture services	0.82	1.52	0.63	0.77
Mining	1.15	15.82	0.85	13.70
Construction	1.28	1.67	1.29	1.77
Manufacturing	1.29	0.46	1.74	0.59
Trans. and utilities	1.20	1.42	2.11	3.18
Trade	0.92	0.98	0.75	0.71
FIRE	0.81	0.67	0.72	0.49
Services	0.77	0.54	0.55	0.32
Government	0.85	1.18	0.71	1.03

3.10.4 Property Valuation and Taxation Revenues

Property valuation includes property assessed by the State of Wyoming and locally assessed property values, on which extraction taxes are based. The State of Wyoming assesses taxes on mineral and nonmineral properties. Nonmineral property assessed by the state includes airlines, utilities, pipelines and gas distribution systems, railroads, and telephone service. During 2007, the total local and state assessed valuation was $20.5 billion, of which 36% is attributed to property in the study area ($7.4 million). Table 3-32 summarizes these figures.

In the study area in 2007, oil and gas accounts for 76% of the total assessed valuation for this three-county area. This is up from 33% in 1990. Sublette County's oil and gas valuation has increased 29 fold over the past 17 years; overall, across the study area, oil and gas valuation has increased by more than a factor of 10. As production has grown in the study area over the past 17 years, its proportion of Wyoming's total oil and gas valuation has also increased, from 20% in 1990 to 50% in 2007.

Table 3-32. Assessed Valuation in the Study Area and in Wyoming (Nominal dollars)

Total	1990	1995	2000	2005	2007	Pecent-age Change 1990–2007
Lincoln Oil and Gas	$48,333,977	$160,875,140	$185,280,292	$415,449,292	$498,586,054	932%
Sublette Oil and Gas	$127,601,135	$177,845,233	$372,368,097	$2,734,591,536	$3,791,216,194	2871%
Sweetwater Oil and Gas	$308,828,613	$347,227,197	$409,430,649	$1,038,277,944	$1,356,877,434	339%
Study Area Oil and Gas	$484,763,725	$685,947,570	$967,079,038	$4,188,318,772	$5,646,679,682	1065%
All Assessed Valuation in Study Area	$1,474,492,175	$1,697,251,304	$2,039,938,850	$5,499,039,604	$7,414,532,986	403%
Wyoming Oil and Gas Assessed Valuation	$2,428,805,052	$1,959,097,757	$2,532,986,276	$8,673,120,744	$11,303,378,284	365%
Proportion of Study Area Oil and Gas to Total Wyoming Oil and Gas	20%	35%	38%	48%	50%	
Proportion of Oil and Gas to Total in Study Area	33%	40%	47%	76%	76%	

Source: Wyoming Department of Revenue Annual Reports 1990, 1995, 2000, 2005, and 2007.

Mineral production in the socioeconomic study area is a major source of tax revenue for federal, state, and local government entities. For instance, in 2007, oil and gas accounted for 76% of the value of property assessed in the socioeconomic study area. In addition, physical assets of the oil and gas industry (property) composed 31% of all property assessed by local governments in 2005.

Ad Valorem Taxes

Ad valorem taxes from mineral production have been summarized from Wyoming Department of Revenue Annual Reports, and county taxes have been estimated based on production level, assessed values, and effective tax rates. Table summarized the total property taxes, mineral ad valorem tax revenues, and estimated ad valorem revenues from oil and gas in the study area and in Wyoming. These figures are shown in nominal dollars, which better describes the relative importance of the tax revenues to the local and state governments over time.

Table 3-33. Property Taxes, Mineral and Ad Valorem Tax Revenues, and Estimated Oil and Gas Ad Valorem Revenues, 2000–2007 (nominal dollars)

Area	2000			2005			2007		
	All Property Taxes	Ad Valorem Mineral Taxes	Oil and Gas Ad Valorem Estimate*	All Property Taxes	Ad Valorem Mineral Taxes	Oil and Gas Ad Valorem Estimate*	All Property Taxes	Ad Valorem Mineral Taxes	Oil and Gas Ad Valorem Estimate*
Lincoln	$27,823,749	$16,545,385	$12,041,551	$46,634,960	$29,863,410	$25,179,551	$58,334,695	$36,197,272	$30,850,511
Sublette	$28,877,352	$22,587,773	$23,563,826	$171,222,261	$159,931,009	$159,907,975	$242,523,833	$224,804,720	$224,705,384
Sweetwater	$76,626,032	$48,186,537	$29,147,777	$119,939,546	$87,912,768	$67,360,358	$158,851,593	$117,121,462	$88,806,271
Total Study Area	$133,327,133	$87,319,695	$64,753,154	$337,796,767	$277,707,187	$252,447,884	$459,710,121	$378,123,454	$344,362,166
Wyoming	$529,421,990	$265,433,379	$179,796,432	$1,044,942,814	$679,817,058	$540,158,681	$1,376,924,563	$913,011,683	$712,637,118

Source: Wyoming Department of Revenue Annual Reports 2000, 2005, and 2007.

*Estimated by multiplying the oil and gas assessed valuation by the mill levy for the county or state. If actual figures were available (for Wyoming in 2005 and 2007), they were used.

In 2000, ad valorem mineral taxes comprised 50% of all property tax receipts paid to the state. Of those mineral tax receipts, 68% were from oil and gas activities. In 2000, the study area accounted for 36% of those oil and gas ad valorem taxes in the state. Between 2000 and 2007, property taxes have more than doubled in the state, driven by ad valorem mineral tax revenue growth (244% increase) and specifically oil and gas ad valorem tax revenues, which has grown by 299% over this period). In 2007, mineral ad valorem revenues account for 77% of all property taxes in the state (up from 50% in 2000), of which oil and gas account for 78%. In 2007, the study area accounted for 48% (up from 36% in 2000) of all oil and gas ad valorem tax revenues in the state. This increase has been driven by production in Sublette County, which has seen increased oil and gas ad valorem tax revenues grow from $23.6 million in 2000 to $224.8 million in 2007.

Approximately 20% of the ad valorem revenues accrue directly to the counties, while the remainder funds local schools and the State School Foundation (Wyoming Department of Revenue, 2006 Annual Report). With new recapture provisions for school funding in Wyoming, much of the ad valorem tax revenues going to county schools is recaptured by the State School Foundation and is now allocated by the state.

State Mineral Severance Taxes

Local and state government entities benefit from severance taxes collected on mineral production throughout the state. Table 3-34 estimates the severance taxes generated from oil and gas production originating within the socioeconomic study area. The estimated severance taxes for both oil and gas are based on production as reported by the Wyoming Oil and Gas Conservation Commission; the sales percentage of production (91%) as reported by the Wyoming Department of Economic Analysis, Consensus Revenue Estimating Group (2006); and the severance tax per unit as reported by the Wyoming Department of Revenue for each year analyzed.

Table 3-34. Estimated Severance Taxes Generated in the Socioeconomic Study Area for Oil and Gas Production, 2001–2007 (Nominal Dollars)

Area	2001			2005			2007		
	Oil	Gas	Total	Oil	Gas	Total	Oil	Gas	Total
Lincoln	$1,111,646	$1,100,205	$2,211,851	$1,351,667	$17,703,200	$19,054,867	$2,177,281	$21,128,008	$23,305,289
Sublette	$4,849,026	$6,079,647	$10,928,673	$9,053,269	$172,647,203	$181,700,472	$19,311,541	$238,838,477	$258,150,019
Sweetwater	$5,674,447	$2,776,016	$8,450,463	$8,542,991	$47,065,355	$55,608,347	$15,618,573	$55,782,891	$71,401,464
Study Area	$11,635,119	$9,955,868	$21,590,987	$18,947,927	$237,415,758	$256,363,685	$37,107,395	$315,749,377	$352,856,771
Wyoming	$72,446,695	$19,814,902	$92,261,597	$91,622,329	$424,235,464	$515,857,793	$147,069,192	$534,200,412	$681,269,604

In 2001, severance taxes generated by study area oil and gas operations were approximately $21.6 million and 23% of all severances taxes generated by oil and gas activities in the state. Both oil and gas revenues contributed fairly evenly across the study area (oil even a bit more). In 2001, Sublette and Sweetwater County production contributed $10.9 million and $8.5 million, respectively, to severance tax receipts. In 2007, the study area severance tax estimate is approximately $352.9 million, a 16-fold increase of $331 million over the 6-year period. In 2007, Sublette County accounted for 73% of the study area severance taxes generated by its considerable gas production. In 2007, gas production accounts for 89% of the oil and gas severance tax receipts in the study area. The study area accounts for 52% of the $681.3 million paid in 2007 for severances taxes associated with oil and gas activity (compared with 23% in 2001) in the state. In 2001, 2005, and 2007, total severance taxes collected from all activities were $355.1 million, $649.3 million, and $882.4 million, respectively (Wyoming Department of Revenue Annual Reports). The 2007 study area estimated oil and gas severances taxes account for 40% of all these severance tax revenues to the state and local governments (in 2001, it was 6%).

Although severance taxes collected on mineral production do not go directly to the counties and towns of origin, they are redistributed across the state according to a formula published in the state statutes, which is primarily based on population. Severance tax revenues are distributed to government entities, including the state general fund, mineral trust fund, water development account, capital construction accounts, state highway funds, and counties, cities, and towns. Therefore, the government entities within the socioeconomic study area will benefit from only a percentage of severance taxes collected on production within the study area. According to the Wyoming Department of Revenue's Annual Report (2007), 2.5% of severance tax revenues are allocated to towns and counties.

Local towns and counties often bear the brunt of the gas boom, having to provide for housing needs, infrastructure, utilities, educational services, and community services (i.e., healthcare, counseling, law enforcement, emergency services, etc.), among many others. Annual budgets and expenditures for these counties and towns have been increasing at various rates, with Sublette County's budget rising at 300% over the past 5 years (see Section 3.10.5, Local Economy Expenditures). Many government officials would like a larger portion of the severance tax revenues to return to where the development and production is occurring to help to defray these considerable government expenditures.

Federal Royalties

Leasable mineral production taking place on BLM-administered public lands is assessed a federal mineral royalty. Oil and gas and surface-mined coal production is assessed at 12.5% of value after allowable deductions. Some of the other mineral production is assessed at lower rates. For example, production of coal mined underground is assessed at 8%, and federal royalties for trona production vary from 5% to 8%.

The Federal Government returns 50% of the total collected royalties to the state in which the mineral production occurred. In Wyoming, the distribution of the federal royalties is based on a formula promulgated by the Wyoming statutes. The state allows a percentage of these federal royalties to be distributed to cities and towns for planning, construction, and maintenance of public facilities; capital construction funds; and transportation projects. In addition, local school districts may benefit from federal royalty payments through advanced entitlement grants for capital construction funds. Local government entities receive only a percentage of federal royalty payments generated from production within the planning area.

In 2007, cities and towns within the three-county study area received $2.4 million or 13% of the total $18.6 million dispersed to cities and towns across Wyoming (Wyoming Treasurer's Office Annual Report 2007). These town and city disbursements do not include additional Federal Mineral Royalty allocations for city, town, county, or school capital construction projects. Total disbursements to cities, counties, and special districts for capital construction (including direct city and town allocations) were $31.6 million. Additional disbursements for school capital construction were $160.7 million. Table 3-35 summarizes these Federal Mineral Royalty allocations.

Total Federal Mineral Royalties distributed to local and state government agencies in Wyoming in FY2007 were more than $927 million. In 2000, total Federal Mineral Royalty disbursements to state and local governments were $309 million. From 2000 to 2007, there was more than a seven-fold increase in total Federal Mineral Royalty receipts to the state.

Table 3-35. Allocations of Federal Mineral Royalties to Local and State Governments and Projects, 2001–2007 (Nominal Dollars)

	2001	2000 Percentage of Total	2007	2007 Percentage of Total
All cities and towns	$19,588,385	6.3%	$18,562,500	2.0%
Paid to cities and counties within the study areas	$2,878,297	0.9%	$2,434,799	0.3%
Cities, counties, and special districts capital construction (exclusive of all cities and towns)	$13,795,788	4.5%	$13,050,000	1.4%
School capital construction	$10,323,190	3.3%	$160,703,329	17.3%
Highway funds	$19,914,162	6.4%	$66,472,500	7.2%
Total Federal Mineral Royalties paid to Wyoming state and local governments	$309,092,856		$927,155,177	

Source: State of Wyoming Treasurer's Office, Annual Report, 2007.

Other Tax Revenue Sources

Other tax revenue sources that may be affected by management actions associated with BLM-managed lands include lodging taxes, sales and use taxes, property taxes, and gas taxes. According to the Wyoming Department of Revenue Annual Sales and Use Tax Distribution Reports, lodging taxes are relatively small compared with other tax sources, remaining approximately 1% of the revenues over the 5-year period shown below (Table 3-36). These taxes have increased over the past 5 years, by 113%. In 2006, sales, use, and lodging generated approximately $144 million in tax revenues.

Table 3-36. Sales, Use, and Lodging Taxes Generated by the Study Area, 2001–2006 (Nominal Dollars)

Location	2001	2002	2003	2004	2005	2006
Lincoln	$9,400,135	$11,798,841	$13,994,660	$13,804,823	$13,718,253	$18,522,674
Sublette	$15,494,269	$20,927,245	$20,925,743	$28,115,784	$37,379,058	$52,285,233
Sweetwater	$42,716,228	$46,240,823	$44,050,489	$49,694,530	$58,940,040	$73,377,462
Study Area	$67,610,632	$78,966,909	$78,970,892	$91,615,137	$110,037,351	$144,185,369

Payment in Lieu of Taxes

Each county in the socioeconomic study area also receives payments in lieu of taxes (PILT) to compensate for revenues lost in instances in which federal lands are exempt from local property taxes. PILTs are allowed in addition to other revenue-sharing programs such as federal mineral royalties and U.S. Forest Reserve payments. The PILT made to each county is based on a complex formula that takes into account revenue sharing from the previous year, county population, and acreage of the county in federal ownership. PILTs received by each of the three counties for the past 13 years are summarized in Table 3-37. Currently, the three counties are receiving approximately $3 million in PILTs.

Table 3-37. PILT for the Study Area, 1995–2007

Year	Lincoln	Sublette	Sweetwater	Total Study Area
1995	$288,298	$225,819	$789,808	$1,303,925
1996	$348,238	$264,198	$920,730	$1,533,166
1997	$344,289	$233,474	$863,835	$1,441,598
1998	$362,946	$244,059	$858,921	$1,465,926
1999	$394,822	$240,299	$902,308	$1,537,429
2000	$418,646	$256,483	$949,649	$1,624,778
2001	$616,591	$371,922	$1,321,047	$2,309,560
2002	$643,309	$391,914	$1,389,460	$2,424,683
2003	$720,614	$442,097	$2,431,305	$3,594,016
2004	$742,253	$461,105	$1,590,760	$2,794,118
2005	$757,883	$481,089	$1,624,031	$2,863,003
2006	$817,726	$491,999	$1,699,056	$3.008,781
2007	$815,710	$487,682	$1,691,978	$2,995,370

Source: US Department of the Interior, National Business Center, PILT County Payments, 1995 through 2007.

3.10.5 Local Economy Expenditures

Sublette, Lincoln, and Sweetwater counties have seen considerable growth in their annual budgets. Sublette County's budget has grown more than 300% between 2002 and 2007 (ERG 2007; Sublette County 2007) and was approximately $117 million in 2007. Additionally, the communities within Sublette County have also seen considerable increases in their budgets. However, even though budgets are increasing, the demand for county and municipal expenditures is also increasing because of community and infrastructure needs associated with population growth driven primarily by oil and gas activity. Many of these county capital investment projects include street construction, repair and paving, construction of and upgrades to water and sewer systems, land acquisition for housing developments, and expansions in solid waste facilities (ERG 2007). Moreover, Sublette County has expanded its Pinedale school facilities for grades 5 and 6 and is discussing building a new elementary and high school. In the Sublette County Road and Bridge Department, 17 new employees have been hired in the last 10 years. There have also been considerable increases in expenses for applying magnesium chloride to reduce dust levels on non-paved roads (ERG 2007).

Annual budgets for towns in Sublette County, including Big Piney, Mableton, and Pinedale, have experienced substantial increases between 2002 and 2007—350%, 1400%, and 600%, respectively (ERG 2007). Recent projects include maintaining buildings; acquiring land for housing; paving and repairing town streets; building a recreation center; renewing, upgrading, and expanding water and sewer systems; drilling new municipal water wells; building new waste disposal and recycling facilities; and making park improvements (ERG 2007).

Lincoln County has also experienced growth in its budgets, although at not as high a rate. Over the same 5-year period, Lincoln County's General Fund grew 28%. For the 2006/2007 fiscal year, the General Fund had total expenditures of $19,512,006. In Sweetwater County, the annual county budget for 2007/2008 was $139,630,505. Over the past 5 years, the annual budget has increased by approximately 23%. Lincoln and Sweetwater County budgets are growing at an annual average of about 5.5%. However, this type of government growth is dwarfed by that in Sublette County, which has grown at an average annual rate of 75%.

3.10.6 Economic Activities Attributable to BLM Lands

Activities on BLM-administered lands can provide important economic stimulus to local economies. For the planning area, activities such as oil and gas production, grazing, and recreation are important to the region. This section discusses the link between activities on lands within the planning area and the local economy.

Historic oil and gas production data were used to estimate annual production for the planning area between 1978 and 2004, as summarized in Figures 3-33 and 3-35. Sublette County was the largest producer of natural gas and the third largest producer of oil in Wyoming in 2005. This observation is consistent with data presented on earnings and employment within the economic study area, which demonstrated the importance of the mining industry, including oil and gas operations even though it is quite possible some of the employment and earnings growth is occurring outside the study area. This industry remains an important economic driver for the socioeconomic study area. Much of this production occurred on public lands, highlighting the importance of oil and gas production in this area.

Annual production data were then used in combination with the average taxable valuation per unit and average tax and royalty rates to estimate ad valorem taxes (county), severance taxes (state), and federal royalties from production on BLM-administered lands within the planning area. Oil and gas production in the planning area generated an estimated $221 million in mineral tax revenues to the county, state, and federal governments during 2001. Oil and gas production in the planning area accounted for 33% of the ad valorem taxes in the socioeconomic study area. However, for the two counties in which the planning

area is located (Lincoln and Sublette), oil and gas production accounted for 91% of county ad valorem tax revenues. In addition, production from the planning area resulted in 58% of the severance taxes generated in the three-county socioeconomic study area in 2000.

Livestock grazing is another important use of BLM-administered lands within the planning area. To understand the economic importance of livestock grazing on public lands, an estimate of the percentage of agricultural sales in the three-county socioeconomic study area attributable to grazing within the planning area was made using data and information from BLM, the Wyoming Statistical Service, and the National Agriculture Statistical Service. The value of grazing on BLM public lands within the planning area was estimated to be more than $2.5 million per year as summarized in Table 3-38 and accounted for almost 6% of total agricultural sales in the area.

Table 3-38. Percentage of Agricultural Sales in Study Area Attributed to Grazing on BLM Lands in the Pinedale Field Office for 2002

Total Agricultural Sales—Study Area ($ thousands)	Total Livestock Sales—Study Area ($ thousands)	Estimated Value of Grazing on BLM Lands—Pinedale Field Office ($ thousands)	Percentage of Total Livestock Sales	Percentage of Total Agricultural Sales
$58,428	$42,021	$2,731	6.5%	5.9%

Source: U.S. Department of Agriculture, National Agriculture Statistical Service, *Census of Agriculture, 2002.*

These estimates likely do not fully describe the importance of grazing on federal lands to the socioeconomic study area. Previous studies have found that the importance of federal AUMs can appear unimportant when calculated on an acreage or per AUM basis. However, many ranching operations are strictly structured with a high seasonal dependence on public land forage, so that private ranch lands can produce hay for winter feed. As a result, although most ranches in this area are only partially dependent on federal land grazing for forage, it can be critical to overall ranch viability.

The economic viability of ranching throughout the socioeconomic study area is also important to retaining private lands in agriculture production. For instance, the American Farmland Trust (AFT) estimated that Sublette County ranks 13th out of the top 25 counties in 7 western states with "prime" ranchland (see glossary for definition of prime ranchland) at risk for conversion to residential development (AFT 2002). The potential loss of prime ranchland could have important implications for the agricultural setting in the socioeconomic study area as well as indirect impacts on wildlife and local government services.

Ranching provides additional benefits and values to the communities within the study area that are not captured in the market. These include open space, cultural ways of life, regional identity association, and preservation of biodiversity. These values are not captured in this analysis.

Recreational activity has important economic value in the satisfaction it provides local residents and the economic activity it generates for the regional economy. Recreational activities in the planning area center especially on the extensive fish and wildlife resources and scenic attributes of the area. With regard to economic activity, recreation generates additional spending in the local economy that supports jobs and income. Estimates of recreational use in the planning area indicate that more than 300,000 nonconsumptive recreational visitor days and 40,000 hunting visitor days are spent in this area per year (USDI, BLM 2003a). From 1998 to 2002, the most popular recreational activities were float or raft trips, fishing, camping, and hiking, walking, and running.

In 2000, the Wyoming Business Council and the Wyoming State Office of Travel and Tourism published a study addressing the trends and effects of tourism on the Wyoming state economy. The study showed that tax revenues generated from travelers in the state increased by 10% during a 3-year period (Wyoming Travel Industry 2000). As visitors come to this area to recreate, they spend money on goods and services

to support their activities, such as lodging, eating and drinking, and gasoline. Money spent by local recreators is assumed to be shifting from one sector to another in the local economy and thus does not stimulate new revenue. However, local recreation spending is still important because it keeps money in the local economy, helping to maintain jobs and reducing employment and income fluctuations that may occur if this money were spent outside the local economy. These expenditures can be an important economic stimulus to the local area. Thus, outdoor recreation is important to the region because of the satisfaction it brings to residents and economic stimulus it provides for the regional economy.

Using the average value per recreational visitor day from the Socioeconomic Analysis for the Jonah Infill Drilling and South Piney Projects EIS, the nonconsumptive average value per visitor day was $22.82 in 2000 dollars (excluding big game hunting). When this is inflated with southwestern Wyoming's cost of living factors, the value is $29.62 in 2006 dollars. The average hunting value per visitor day is $100.27 in 2006 dollars (see Table 3.61, in TRC Mariah Associates Inc. 2005). Thus, recreation in the planning area generates approximately $12.9 million annually to the three-county socioeconomic study area.

3.10.7 Social and Demographic Characteristics

Demographic Characteristics

Population data estimates and age demographics for the study area and the State of Wyoming were obtained from the U.S. Census Bureau and are summarized in Table 3-39. Population estimates were available for the counties and the state for 2007, but age demographic information was only available for 2006. According to this source, overall population increased in the socioeconomic study area between 1990 and 2007 by 12%. However, population growth varied across the area, with Sweetwater County reporting almost no growth in population (1%) and Lincoln and Sublette reporting a 27% and 62% increase, respectively, between 1990 and 2007. The population across Wyoming increased by 15% between 1990 and 2007.

Table 3-39. Population Trends within the Study Area and State of Wyoming

Area	1990	2000	2007 (Age= 2006)	Percentage Change (1990–2000)	Percentage Change (2000–2007/6)	Percentage Change (1990–2007/6)
Lincoln	12,710	14,573	16,171	15%	11%	27%
25 to 44	3,713	3,703	3,971	–0.3%	7%	7%
55 to 74	1,700	2,404	2,927	41%	22%	72%
Sublette	4,883	5,920	7,925	21%	34%	62%
25 to 44	1,628	1,627	1,999	0%	23%	23%
55 to 74	763	1,079	1,449	41%	34%	90%
Sweetwater	38,792	37,613	39,305	–3%	4%	1%
25 to 44	13,563	11,031	10,124	–19%	-8%	-25%
55 to 74	3,994	4,568	6,311	14%	38%	58%
Study Area	56,385	58,106	63,401	3%	9%	12%
25 to 44	18,904	16,361	16,094	–13%	-2%	-15%
55 to 74	6,457	8,051	10,687	25%	33%	66%
Wyoming	453,690	493,782	522,830	9%	6%	15%
25 to 44	148,054	138,619	133,401	–6%	-4%	-10%
55 to 74	63,100	75,933	93,308	20%	23%	48%

The socioeconomic study area mirrors the remainder of the state, which has a very small population of minority groups. The percentage of ethnic groups other than "white" or "American Indian" in the socioeconomic study area is quite small, which is common throughout Wyoming.

The percentage of people aged 25 to 44 years old decreased considerably (–15%) in the socioeconomic study area between 1990 and 2006. However, older age groups increased by 66% in the study area during this same period. The decrease in younger adults (aged 25 to 44) was driven by decreases in Sweetwater County; Sublette and Lincoln counties experienced increases between 1990 and 2007—23% and 7%, respectively. The age distribution for the rest of the state showed similar trends during the same time frame, with the percentage of adults ages 25 to 44 decreasing by 10% while older individuals increased by 48%.

Personal Income and Cost of Living

Personal income data were obtained for each county in the socioeconomic study area from the BEA, Regional Economic Accounts. Total personal income for the study area increased to $2.5 billion in 2006, up from about $990 million in 1990, an increase of 151% in nominal dollars. However, the cost of living in Wyoming, and especially in southwestern Wyoming, has also been increasing, which has resulted in a smaller amount of real income growth. Wyoming's rate of inflation has averaged 4.48% over the past 4 years (2003–2006), with the largest increases in 2004 (4.9%) and 2006 (5.6%) (Wyoming Division of Economic Analysis, 2008). Southwestern Wyoming's inflation rates have been even higher over the same period, with an average of 5.58%. In comparison, the consumer price index, which tracks all prices for the United States, has averaged 2.78% between 2003 and 2006. In the past 3 years, southwestern Wyoming has experienced even higher rates of inflation than those experienced by the State of Wyoming—6.6%, 7.6%, and 6.2% annual inflation rates in 2005, 2006, and 2007, respectively.

To account for the cost of living impacts on income, the income tables in this section have been deflated with rates published by the State of Wyoming, Economic Analysis Division, Wyoming Cost of Living Index for the Southwestern Wyoming region to represent income figures based on 2006 dollars. This allows an assessment of real income increases over time based on constant dollar figures. Once inflation impacts have been accounted for, real personal income in the study area has increased 36% between 1990 and 2006 (compared with 151% in nominal dollars).

Personal income can be broken into three categories: labor earnings, investment income, and transfer payments. Labor earnings are derived through wages, salaries, and self-employment income. Investment income includes rents, dividends, and interest earnings, known simply as money earned from investments. Finally, transfer payments are derived largely from retirement benefits, Social Security benefits, Medicare and Medicaid benefits, healthcare and disability insurance payments, and other government payments to individuals. Personal income data are summarized in Table 3-40.

Table 3-40. Personal Income Trends within the Study Area (2006$, Thousands)

Area	1990	2000	2001	2002	2003	2004	2005	2006
Lincoln								
Earnings	220,614	260,499	284,591	296,761	328,786	324,475	312,023	334,637
Investment Income	78,956	123,840	116,764	100,886	105,567	112,197	104,217	84,680
Transfer Payments	38,614	53,848	58,244	64,005	66,570	67,384	65,712	66,159
Total Personal Income	338,184	438,186	459,598	461,652	500,923	504,055	481,951	485,476
Nonlabor Income Percentage	35%	41%	38%	36%	34%	36%	35%	31%
Sublette								
Earnings	99,541	115,891	132,808	147,653	169,273	185,048	209,859	250,370
Investment Income	51,064	75,137	72,070	70,083	71,358	82,197	74,654	79,066
Transfer Payments	16,989	22,833	23,521	25,126	26,237	26,498	25,732	25,927
Total Personal Income	167,594	213,860	228,400	242,862	266,868	293,744	310,244	335,363
Nonlabor Income Percentage	41%	46%	42%	39%	37%	37%	32%	31%
Sweetwater								
Earnings	992,777	1,013,101	998,788	1,004,434	1,043,647	1,090,577	1,144,406	1,252,317
Investment Income	198,100	279,752	265,152	263,526	267,936	221,842	229,922	226,069
Transfer Payments	119,540	143,310	146,877	159,134	163,033	158,885	152,849	153,950
Total Personal Income	1,310,418	1,436,163	1,410,816	1,427,094	1,474,616	1,471,304	1,527,177	1,652,317
Nonlabor Income Percentage	24%	29%	29%	30%	29%	26%	25%	23%
Study Area								
Earnings	1,312,932	1,389,490	1,416,186	1,448,847	1,541,706	1,600,100	1,666,288	1,837,324
Investment Income	328,120	478,728	453,986	434,496	444,861	416,236	408,792	389,815
Transfer Payments	175,143	219,990	228,641	248,265	255,840	252,767	244,292	246,036
Total Personal Income	1,816,196	2,088,208	2,098,814	2,131,608	2,242,407	2,269,103	2,319,372	2,473,156
Nonlabor Income Percentage	28%	33%	33%	32%	31%	29%	28%	26%

Source: BEA, Regional Economic Accounts: Labor earnings are net earnings by place of residence; transfer payments are personal current transfer receipts; personal income figures were inflated with the Southwestern Wyoming Cost of Living Index to represent real 2006 dollar values. The inflation index is presented in Table 3-23.

The socioeconomic study area is showing signs of shifting patterns of income growth. Overall, personal income has grown across the study area. Since 1990, real personal income has risen 36%, an average increase of 2% per year. However, there are variations across the three-county study area. Personal income in Sweetwater and Lincoln counties is growing at lower rates than the rate experienced by Sublette County. Since 1990, Sweetwater, Lincoln, and Sublette counties have grown 26%, 44%, and 100% in personal income, which is an average annual rate of 2%, 3%, and 6%, respectively. Since 2000, Sublette County has experienced 9% annual growth in personal income while Sweetwater and Lincoln counties have grown at an average rate of 2% and 3% over that same period, respectively. Table 3-41 summarizes these trends.

Nonlabor income (both transfer payments and investment income) in the study area is showing some interesting trends. While the annual growth in transfer payment income growth has remained relatively stable across the study area (2% to 1% for Sweetwater, 3% to 2% for Sublette County, and 4% to 4% for Lincoln County), investment income has recently been decreasing across the study area. In the study area, investment income increased 19% between 1990 and 2006, yet has decreased more recently by 19% between 2000 and 2006. Lincoln, Sublette, and Sweetwater counties have seen similar trends—a percentage increase from 1990 to 2006 of 7%, 55%, and 14% in investment income, yet Lincoln and Sweetwater counties have experienced negative 32% and negative 19% growth in investment income between 2000 and 2006. Sublette County's investment income has had very slow growth at 1% annually between 2000 and 2006. Nonlabor income as a percentage of total personal income has been decreasing steadily since 2000 for all three counties; Sublette County non-labor income as a percentage of total personal income was 46% in 2000, and in 2006, it was 31% (See Table 3-40).

It is evident that labor earnings are driving the increases in personal income in the study area and offsetting the reductions in investment income in the area. It also appears that in Lincoln and Sweetwater counties, investment income has been decreasing since 2000, on average approximately 5% and 3% annually. Sublette County was experiencing 3% annual average growth in investment income between 1990 and 2006, yet over the past 5 years, there has been a much more modest growth in investment income in this county. From 2004 to 2005, there was a decline in investment income of 5.6 % in Sublette County, yet from 2005 to 2006, it increased by 5.9%. Table 3-41 summarizes some of these trends.

Table 3-41. Real Personal Income Changes (Based on 2006$)

Area	Percentage Change 1990–2006	Percentage Change 2000–2006	Average Annual Percentage Change 1990–2006	Average Annual Percentage Change 2000–2006
Lincoln County				
Labor Earnings	52%	28%	3%	5%
Investment Income	7%	-32%	0%	-5%
Transfer Payments	71%	23%	4%	4%
Total Personal Income	44%	11%	3%	2%
Sublette County				
Labor Earnings	152%	116%	9%	19%
Investment Income	55%	5%	3%	1%
Transfer Payments	53%	14%	3%	2%
Total Personal Income	100%	57%	6%	9%
Sweetwater County				
Labor Earnings	26%	24%	2%	4%
Investment Income	14%	-19%	1%	-3%
Transfer Payments	29%	7%	2%	1%
Total Personal Income	26%	15%	2%	3%
Total Study Area				

Area	Percentage Change 1990–2006	Percentage Change 2000–2006	Average Annual Percentage Change 1990–2006	Average Annual Percentage Change 2000–2006
Labor Earnings	40%	32%	2%	5%
Investment Income	19%	-19%	1%	-3%
Transfer Payments	40%	12%	3%	2%
Total Personal Income	36%	18%	2%	3%

Source: BEA, Regional Economic Accounts; inflated with Southwestern Wyoming's Cost of Living Index.

Per capita income is also increasing. In 2006, both Sweetwater and Sublette County's per capita income was greater than the state and the national averages, while Lincoln County's personal income was below the state and national per capita income averages. The study area overall has experienced 18% growth in per capita income between 2000 and 2006, driven by Sublette County's 37% per capita growth, and to a lesser extent Sweetwater's growth of 14%, during this same period. The State of Wyoming has also seen increasing per capita income trends over the same period of 12%, while the United States has seen more moderate real per capita income growth over the past 5 years of 6%. Table 3-42 summarizes these trends.

Table 3-42. Real Per Capita Income Trends (2006$)

Location	1990	2000	2006	Percentage Change (1990–2006)	Percentage Change (2000–2006)
Lincoln	$26,610	$29,931	$30,812	16%	3%
Sublette	$34,324	$35,926	$49,077	43%	37%
Sweetwater	$33,782	$38,288	$43,463	29%	14%
Study Area (Average)	$31,572	$34,715	$41,117	30%	18%
Wyoming	$32,548	$36,227	$40,655	25%	12%
United States	$29,377	$34,621	$36,714	25%	6%

Source: Bureau of Economic Analysis, Regional Economic Accounts; study area data were inflated with Southwestern Wyoming Cost of Living Index; Wyoming was inflated to represent real 2006 dollar values.

Real median household income has been increasing recently in the study area for Sublette and Sweetwater counties at rates of 11% and 2%, respectively, between 2000 and 2005. Lincoln County's median household income has fallen slightly over this period. Since 1990, Sweetwater's real median household income level has decreased (18%), while Sublette and Lincoln counties have seen constant or very slight decreases in growth over this 16-year period. Overall, in Wyoming, the cost of living is offsetting the growth in household income, resulting in constant real household income over this period. Table 3-43 summarizes these figures.

Table 3-43. Real Median Household Income Trends (2006$)

Location	1990	2000	2005	Percentage Change (1990 to 2005)	Percentage Change (2000 to 2005)
Lincoln	$52,442	$52,958	$52,283	0%	-1%
Sublette	$57,527	$50,687	$56,291	-2%	11%
Sweetwater	$75,468	$60,414	$61,559	-18%	2%
Wyoming	$48,990	$48,237	$48,049	-2%	0%
United States	$45,324	$48,713	$47,398	5%	-3%

Source: American Fact Finder, US Census Bureau; study area data inflated with southwestern Wyoming Cost of Living Index; Wyoming inflated with Wyoming Cost of Living Index; and US figures inflated with CPI for All Urban Consumers to represent real median household income in 2006$.

Housing

Housing is unevenly distributed throughout the study area, with most found in the larger populated areas in Sweetwater County (e.g., Rock Springs, Green River). Information on housing rental occupancy was obtained from the Wyoming Housing Database Partnership and summarized in Table 3-44. These data are based on housing surveys implemented in June and July of each year, and therefore represent an estimate of housing units and vacancy rates in the summer of each year and does not capture year-round vacancies.

Sweetwater County had the highest percentage of owner-occupied units in 2006 (72.6% of total units in the three-county study area), highest number of renter-occupied units (1,266), and a very low vacancy rate (1.9%). Lincoln and Sublette counties have considerably fewer rental units available (317 and 159, respectively). All three counties have seen a considerable increase in the number of rental units available, with Sublette County rental units increasing by 288% during the 5-year period. However, vacancy rates are extremely low in all parts of the study area; only 1.9% of the units available in all counties are vacant. Vacancy rates have fallen steadily during the past 5 years in Lincoln and Sweetwater counties. In 2001, Sublette County had only two vacant rental units, with similarly low vacancy rates during the 5-year period. Overall, the amount of available housing for rent in the study area is very low.

Table 3-44. Rental Units and Vacancy Rates in the Socioeconomic Study Area, 2001–2006

Housing Occupancy	2001	2002	2003	2004	2005	2006	Percentage Change 2001–2006	Annual Average Percentage Change
Lincoln County								
Total rental units	287	114	106	176	208	317	10%	14%
Vacant rentals	26	10	7	12	14	6	–77%	–12%
Vacancy rates (%)	9.1%	8.8%	6.6%	6.8%	6.7%	1.9%	–79%	–20%
Sublette County								
Total rental units	41	41	50	59	96	159	288%	34%
Vacant rentals	2	0	2	1	4	3	50%	31%
Vacancy rates (%)	4.9%	0.0%	4.0%	1.7%	4.2%	1.9%	–61%	–16%
Sweetwater County								
Total rental units	821	1,060	1,620	1,369	1,440	1,290	57%	12%
Vacant rentals	67	65	34	12	34	24	–64%	8%
Vacancy rates (%)	8.2%	6.1%	2.1%	0.9%	2.4%	1.9%	–77%	0%

Note: Surveys done in June and July of each year.
Source: Wyoming Housing Database Partnership.

A Sublette County housing report (PAWG SETG 2006) depicts changes in housing stock estimates as well as changes in population for Sublette County from 2000 to 2004 (Figure 3-34). As shown in Table 3-45, Sublette County housing stock has lagged behind the increases in population, creating shortages in housing availability. The report also notes that the population estimates from the U.S. Census Bureau typically do not count those living in nontraditional housing, such as trailers, temporary structures, RVs, motels, "man-camps," etc., which may comprise a large portion of housing in Sublette County.

Rental costs have also been increasing in the study area since 1998. Sublette County has the highest housing rental costs; the average apartment rental costs were $699 for the second quarter of 2005 in Sublette County, compared with $512 in Sweetwater County, $379 in Lincoln County, and $504 for the State of Wyoming. Rental costs for houses are higher than those of apartments but have a similar relative cost across the three counties reported, with Sublette County having the highest rental housing cost. Rental housing costs are summarized in Table 3-45.

Overall, the costs of rental housing have been increasing, most significantly in Sublette County. From 1998 to 2005, rental rates have increased for each type of housing as follows: apartments (81%), mobile

home lots (60%), single-family homes (62%), and mobile homes on lots (42%). The apartment and housing rental prices in Sublette and Sweetwater counties are increasing at average annual rates much higher than those of the State of Wyoming. Sublette County apartment rates are increasing on average 9% per year, Sweetwater County increases are 5% per year, Lincoln County 8% per year, and the State of Wyoming is experiencing 5% per year apartment rental rate increases.

Table 3-45. Rental Housing Costs, 1998–2005[1]

Location	Type of Housing	1998	1999	2000	2001	2002	2003	2004	2005	Percentage Change 2000–2005	Annual Average Percentage Change
Sublette	Apartment	387	425	433	455	472	520	647	699	81%	9%
	Mobile home lot	150	150	175	165	200	200	225	240	60%	7%
	House	546	588	624	608	611	769	808	882	62%	7%
	Mobile home on a lot	415	338	435			472	624	590	42%	9%
Sweetwater	Apartment	363	354	367	368	387	391	427	512	41%	5%
	Mobile home lot	183	188	196	200	202	208	212	214	17%	2%
	House	459	472	485	534	518	539	635	673	47%	6%
	Mobile home on a lot	405	392	389	439	443	449	566	594	47%	6%
Lincoln	Apartment	254	300	245	295	285	414	347	379	49%	8%
	Mobile home lot	153	188	158	175	163	157	163	178	16%	3%
	House	427	440	466	464	441	534	382	407	–5%	0%
	Mobile home on a lot	320	320	311	330	328	403	300	374	17%	4%
Wyoming	Apartment	370	376	386	415	437	452	473	504	36%	5%
	Mobile home lot	154	172	170	178	179	190	188	203	32%	4%
	House	495	520	553	575	605	636	680	693	40%	5%
	Mobile home on a lot	383	400	403	429	451	455	480	505	32%	4%

[1] Housing costs are provided for the second quarter of each year.
Source: Wyoming Department of Administration and Information, Economic Analysis Division—Wyoming Cost of Living Index.

The trend in the value of single-family homes in the study area is summarized in Table 3-46 and shows variation across the area. Sublette and Lincoln counties reported higher overall value and growth rates than the rest of Wyoming, whereas Sweetwater County values were lower than those of the state until 2005 when they moved higher than the state's average. The three counties are experiencing on average, higher annual growth rates in single-family home prices. Sublette County has seen the highest growth rates with a 14.8% increase per year during the past 5 years. Sweetwater and Lincoln counties are also experiencing increasing rates of 10.9% and 8.9%, respectively. The State of Wyoming housing prices have increased on average 7.6% annually since 2000.

Table 3-46. Average Value of Single-Family Homes, 2000–2005

Location	2000	2001	2002	2003	2004	2005	Percentage Change 2000–2005	Annual Average Percentage Change
Lincoln	$123,266	$126,611	$145,630	$153,733	$170,814	$187,924	52%	8.9%
Sublette	$125,922	$149,179	$163,473	$173,116	$218,343	$249,029	98%	14.8%
Sweet-	$108,633	$111,056	$114,838	$121,652	$142,688	$179,000	65%	10.9%
Wyoming	$111,437	$116,469	$121,140	$132,708	$147,588	$160,497	44%	7.6%

The Pinedale Anticline Working Group (PAWG) Socioeconomic Task Group (SETG) Draft Monitoring Plan and Report (March 2006) provides additional information on housing issues for Sublette County. Excerpts from the report are reproduced below.

> *Apartments for rent in Sublette County are extremely scarce. Very few multi-family structures have been built in recent years as compared to single-family homes. The rental market vacancy rate is essentially zero [in 2005]. 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 instances of people converting garages into apartments and renting them out. Camping trailers parked on town streets with people staying in them.*
>
> *Weekly rentals are occupied primarily by service companies and temporary employees mainly related to the gas field. Clearly there is a shortage in the area in markets for all types of rentals. The hotel/motel environment experiences steadily occupied rooms with generally low vacancy rates. Vacancies occur mostly during the winter months. The recently approved year round drilling seems to have had some impact on this trend with a relatively low vacancy rate occurring during winter. Confoundingly, increased winter tourism such as associated with the hockey rink and school sports have also influenced the vacancy situation. With more hotel/motel rooms available during the winter, the Pinedale School System now hosts regional sports events that they weren't able to in past years. With the current lack of room availability, there becomes a definite concern for the tourism market.*
>
> *According to the Sublette County Chamber of Commerce (personal communication, January 2006, Mindy Crabb, director of the Sublette County Chamber of Commerce), an estimated 526 motel-type rooms are available for rent in Sublette County. Of these, over 450 rooms are available for rent to gas-field workers. During the non-winter months, nearly 100% of these rooms are booked, often for weeks-at-a-time, by those employed in the gas fields. A number of motels have exclusive contracts with gas-field companies to house their employees for months or years at a time. During the summer months, the Sublette County Chamber of Commerce indicated they spend a large amount of their time redirecting Pinedale-bound tourists to other areas of the state where lodging is more available. In winter months, county-wide occupancy drops to about 50-75% occupancy, as gas field activity undergoes seasonal fluctuations. A number of Bureau of Land Management seasonal restrictions on gas field activities have been lifted in recent months, and winter-time occupancy rates could rise in response to greater winter-time field activity.*

The PAWG SETG conducted a new housing survey to better understand current housing needs and conditions. This survey provides recent housing information from oil and gas industry-related employees, including where workers normally live/stay, types of housing units occupied, and whether the housing need is temporary or longer term. A summary of the housing survey findings by the Sublette County Socioeconomic Analysis Advisory Committee website can be found at http://www.sublette-se.org/survey.html.

The survey found that among nonresidents (i.e., temporary or rotational workers) currently employed in the gas industry, there appears to be substantial interest in permanently relocating to the area. Potential relocatees tend to be older, married, and have children under the age of 18 compared with those not considering relocation. Those thinking of or planning to relocate also indicated they wished to purchase a home, with more interest expressed in moving to Sublette County (especially the Pinedale and Boulder areas) than to Sweetwater County. However, the vast majority of potential relocatees indicated they would be willing to spend less than $750 a month in housing, costs, which would require a very substantial down payment to afford the average home in Sublette County. When asked their biggest obstacle to moving into the area, the overwhelming majority of people indicated housing affordability and overall housing availability as key.

Overall, housing occupancy data show that all three counties in the study area have decreasing vacancy rates. Anecdotal evidence and housing statistics indicate that rental vacancies no longer exist in the study area, and home values and rental costs are increasing at rates generally well above those of the state. The cost of homes and rental units are increasing at a faster pace than income, causing a deficiency in affordable housing. Sublette County is having trouble raising funds for additional public service infrastructure needed to meet the increases in housing demands. Additional housing demands are likely in the future because more than half of the temporary oil and gas industry workers residing outside the study area that were surveyed are considering permanently moving to the study area (Jacquet 2006).

Schools

Five independent school districts are located entirely or partially within the planning area. Enrollment within these districts continued to fall for much of the 1990s and the first part of the 2000s. The largest declines occurred in the two districts located in Sweetwater County. These two districts lost nearly 3,000 students between 1993 and 2002. However, the Sweetwater School District #1 has experienced a 5% increase in school enrollment between 2003 and 2006. According to one Sweetwater School official, the elementary school has almost reached capacity and the district will need to accommodate the growth in the near future by possibly building a new school (Personal Communication, Sandy Vanvleet, October 18, 2006). The Sweetwater District is expecting future enrollment increases as housing is developed in the area to accommodate immigration to fill the many jobs (both service industry and oil and gas jobs) available in the area. However, school enrollments may not be an accurate indicator of employment in the area because there are a considerable number of temporary workers who are not permanently relocating their families to the study area.

The district located in Lincoln County has also experienced a significant decline in total enrollment, losing nearly 450 students (40% decline) between 1993 and 2002. These declines can be tied to changes in population in this county. According to a school official in Lincoln County School District #1, enrollment has decreased since 1985. However, for 2005 and 2006, enrollment has been stable, which was attributed to the increasing oil and gas development in the area (Personal Communication, Frank Johnson, October 2006). The Lincoln County School District #1 indicates that it believes there will be constant to slight increases in its school enrollment (Personal Communication, Frank Johnson, October 2006) in the near future owing to oil and gas activities in the area.

School districts in Sublette County have reported 208% increase in enrollment between 2000 and 2006. The PAWG SETG has projected population and school enrollment scenarios between 2005 and 2030 for

Sublette County (see http://www.sublette-se.org/projections.html). The PAWG SETG indicates that housing availability will likely be the key factor that determines which of these population and enrollment impact scenarios occurs. Currently, housing availability is so tight that the PAWG SETG believes that the low-impact scenario seems most likely. However, if housing was made available, it is likely the number of short-term workers permanently residing in the county would match the amount of housing available. Under the low-impact scenario, there are steady enrollment increases from 1,250 in 2005 to 3,250 in 2016 (160% increase), followed by slight declines and then constant or slight increases in enrollment back to 3,250 in 2024.

Overall, it is likely that both Sweetwater and Sublette County school districts will need to accommodate future increasing enrollment in their schools by constructing new buildings or purchasing existing properties. It is difficult to predict whether Lincoln County School District's enrollment will indeed increase in the future.

Emergency Services

Recent data have been collected through the PAWG SETG for a number of social and economic indicators for Sublette and Sweetwater counties and for some of the cities in the two counties. Statistics were not available for Lincoln County. For indicators of emergency services, the following two figures demonstrate the need for emergency services, specifically emergency medical service (i.e., ambulance) and fire department runs for Pinedale, Big Piney, and Boulder, all located in Sublette County. Figure 3-36 shows that for the town of Pinedale, the total runs for emergency medical service vehicles increased from 272 in 2000 to 576 in 2004, a 112% increase over a 5-year period. The number of runs for Big Piney has also increased, although not to the extent in Pinedale. Big Piney experienced a 47% increase in emergency medical services between 2000 and 2004.

Similarly, three towns in Sublette County are also experiencing increases in the need for fire department services. As illustrated by Figure 3-37, Pinedale has faced an exponential increase in fire department runs of 1,300% during the 7-year period from 1997 to 2003. Big Piney-Marbleton and Boulder have also required more fire department services during this period—583% and 214% increases, respectively. A combination of several factors, including oil and gas industry development, increased tourist activity, growing population, and an aging population, is likely contributing to the increased need for emergency services (SETG 2006).

Crime and Substance Abuse

Figure 3-38 summarizes the crime rates for the three counties and the State of Wyoming. The crime rate is calculated by dividing the total number of crime incidences (including domestic violence) by the population of the area and multiplying it by 10,000, thereby resulting in a crime rate per 10,000 people. The Uniform Crime Reporting statistics indicate that the crime rate in Sublette County has been increasing steadily since 2002, with an 81% increase in the crime rate between 1999 and 2005. Sweetwater County experienced a slight increase between 2002 and 2004, although in 2005, the crime rate decreased. However, the crime rate for Sweetwater County is above the average for the State of Wyoming. Sublette County's crime rate is currently also above the crime rate for the state. Lincoln County's crime rate has been steady during this period and falls well below the average of the state crime rate.

Figure 3-39 demonstrates the number of aggregated assault incidences occurring in the study area. Between 1999 and 2005, the number of aggravated assault incidences increased by 117% in Sublette County. Domestic violence in Sublette County has also been increasing since 1999, as shown in Figure 3-40—a 265% increase during the 6-year period. Sweetwater County has also experienced an overall increase in assault incidences, with a 45% increase from 1999 to 2005. However, 2005 shows a considerable decrease in these types of crimes in Sweetwater County. Lincoln County has experienced a

constant number of both domestic violence incidences and aggregated assaults during the 6-year period.

According to Sweetwater County Sheriff Mike Dayton, crime has increased in the past few years, but the increase has been proportional to the population increases in the area (Personal Communication, October 15, 2006). That is substantiated by the statistics indicating there has been no percentage change in the crime rate from 1999 to 2005. In addition, he believes that the oil and gas developers have contributed to the community in ways that were not experienced in previous boom times (e.g., providing funds for roads, treatment centers, court costs, and housing).

The PAWG SETG also collected data on various indicators of crime, which are considered a quality of life characteristic for Sublette and Sweetwater counties. The number of index crimes reported and arrests made in Sublette County have continued to increase at a nearly exponential rate since 2000, according to Uniform Crime Reporting statistics compiled by the Office of Wyoming Attorney General (PAWG SETG 2006). The biggest increases in arrests continue to be related to driving under the influence, drug possession, larceny, and "other crimes" thought to be associated with outstanding warrants. Violent crimes (such as rape, murder, felony assault, etc.) have not increased.

The PAWG SETG argues that the reported crime index is strongly correlated to the amount of rig activity in Sublette County, and that rig activity accounts for the temporary workforce residing in the county (SETG 2006). Ninety percent of the changes in the total crime index are explained by changes in oil and gas industry drilling during the 1996–2004 period, which suggests that the temporary workers associated with the oil and gas industry play a significant role in driving the changes in crime (SETG 2006). Crime in Sublette County has grown at rates that outpace the growing population (Figure 3-38). According to Unified Crime Reporting statistics, the number of arrests in Sublette County has increased by nearly 270% since 1995, growing from 110 arrests to 439 arrests in 2004 (Figure 3-41). Between 2000 and 2004, the number of arrests has increased by 94% (SETG 2005).

The socioeconomic analysis produced by TRC Mariah Associates Inc. (January 2005) for the Jonah Infill Drilling and South Piney Projects' EIS provides a detailed description of the crime issues facing Sublette County. Many people were consulted, and references are cited in the text. Part of the crime section from this document is reproduced below.

> *According to Sheriff Ruland, the biggest crime problem in Sublette County is methamphetamine drug abuse. Drug use also leads to increases in domestic violence and bar fights, particularly within the temporary worker demographic. Although there has been an increase in drug use in Sublette County, Ruland does not equate that increase to oil and gas workers; it is a state-wide problem (Royster 2004). Additionally, Ruland recognizes that any increase in population, including visiting hunters and other tourists, result in an increase in drug and alcohol-related calls (Royster 2004). The majority of law enforcement calls in Sublette County still involve traffic (for example, people speeding or running stop signs).*

One study indicates that transient workers pose challenges to law enforcement primarily in the form of reduced highway safety and increased substance abuse (Blevins et al. 2004):

> *...Increases in felonies and drug-related calls have been reported by the Sweetwater County Sheriff and the Chief of Police in Rock Springs; these were primarily attributed to oil and gas workers (crime report to Pinedale/Anticline Working Group (PAWG) presented by Jana Weber) (Personal Communication with Roy Allen, December 2004, Economist, BLM Wyoming State Office, Cheyenne).*

Substance abuse violations were up 209% for adult males and 400% for juvenile males in the interval 2000 to 2006 in Sublette County (Jacquet, 2007). Violations, however, may underestimate the extent of the regional drug problem. There is consensus that crystal methamphetamine use is widespread among

roughnecks in Wyoming. This highly addictive drug can be readily created using household ingredients. Detective Sergeant K.C. Lehr of the Sublette County Drug Task Force indicated that his organization was "not even touching the surface. There's so much [crystal methamphetamine] coming through this community, it would blow our minds" (Fuller 2007).

Traffic

Traffic and congestion is also often cited as a quality of life indicator. According to the SETG (2006) report, both the amount of traffic and the number of accidents have increased appreciably in the past few years on three major highways in Sublette County. However, when comparing this accident rate with other comparable highways in the state, the number of these local incidents is about the same, if not lower. Anecdotal evidence in both Sublette and Sweetwater counties indicates that traffic congestion (for example, truck traffic from oil and gas activities) is considerable.

The *Wyoming BLM Economist* notes that children in Pinedale are being bused from the south side of Pine Street to the north side because of the danger associated with traffic (Personal Communication, Roy Allen, October 2006). In addition, Sweetwater County Sheriff Dayton suggests that Rock Springs is so congested that there are lines at gas stations and overcrowding at restaurants during the lunch hour. The Mayor of Pinedale, Steve Smith, states (Personal Communication, April 29, 2008):

The highway between Pinedale and Rock Springs used to be a kind of a nice scenic drive, and now it's non-stop truck traffic. In fact, the governor requested money to put 17 passing lanes between Pinedale and Rock Springs where there used not to be any. Secondly, the Highway Patrol used to have two highway patrolmen in Pinedale and they were part of the Jackson Hole division. Now Pinedale has just received its own division with a lieutenant and eight patrolmen.

The Pinedale area is also experiencing significantly increased maintenance costs on some of its roads as a result of heavy truck traffic. With the additional oil and gas development and production in the area, it is likely that traffic, vehicle congestion, and road construction in Sublette and Sweetwater counties will continue to increase, lowering the quality of life for those residents and groups who value less traffic and congestion in their area.

Oil and Gas Industry Mortality

Oil and gas extraction, drilling, and support industries for the oil and gas sectors are a growing industry in the United States, employing approximately 380,000 workers in 2006. In recent years, activity in this industry has increased substantially, from an average of 800 actively drilling rigs in the United States during the 1990s to approximately 1,300 between 2003 and 2006. In August 2005, the U.S. Department of Labor's Bureau of Labor Statistics (BLS) asked the Centers for Disease Control and Prevention (CDC) to investigate a 15% increase in fatalities among oil and gas extraction workers (from 85 fatalities in 2003 to 98 in 2004). The CDC Morbidity and Mortality Weekly Report (April 25, 2008/57(16); pp. 429–431) reported on its findings, which are summarized in the following paragraphs.[3]

CDC analyzed data from the BLS Census of Fatal Occupational Injuries (CFOI) for the period 2003--2006. The results indicate that increases in oil and gas industry activity were correlated with an increase in the rate of fatal occupational injuries in this industry, with an annual fatality rate of 30.5 per 100,000 workers (404 fatalities) during 2003 to 2006, approximately 7 times the rate for all workers (4.0 per 100,000 workers). A statistically significant correlation was observed between the number of drilling and workover rigs and the annual occupational fatality rate during 1993 to 2006.

Two types of events accounted for nearly half of all fatal injuries among oil and gas extraction workers in the United States during 2003–2006: highway motor-vehicle crashes (27%) and workers being struck by

3 *This report is available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5716a3.htm.*

tools or equipment (22%). Other events included explosions (9%), falls to lower levels (7%), and fires (7%).

The highest numbers of oil and gas industry occupational fatalities occurred in Texas (153 [38%]), Louisiana (49 [12%]), Oklahoma (43 [11%]), Wyoming (32 [8%]), and New Mexico (22 [5%]). Among the states where most of the fatalities occurred, Wyoming (58.5 per 100,000) had the highest average annual fatality rates, followed by New Mexico (45.2 per 100,000). The authors of the CDC study believe that the correlation between the number of drill rigs and number of fatalities could be a result of several factors, including an increase in the proportion of inexperienced workers, longer working hours, and the use of all available rigs (including older equipment with fewer safeguards).

3.10.8 Environmental Justice

Executive Order 12898, Federal Action to Address Environmental Justice in Minority Populations (Map 3-8) and Low-Income Populations, requires identifying and addressing disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income populations.

Relevant census data for counties within the socioeconomic study area were collected to determine whether the populations residing within the three study area counties constitute an "environmental justice population" by meeting either of the following criteria:

At least one-half of the population is of minority or low-income status

The percentage of the population that is of minority or low-income status is at least 10 percentage points higher than for the entire State of Wyoming.

Population by Race

Table 3-47 summarizes the population distribution by race for all counties in the socioeconomic study area. For Lincoln and Sublette counties, minority populations are well below the state average, whereas Sweetwater County has some minority populations that are slightly above the state average. The data indicate the absence of an environmental justice population based on ethnicity that may be affected by BLM actions.

Table 3-47. Population Distribution (Percentage) by Race by County, 2000

County	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some Other Race	Two or More Races	Hispanic or Latino (of Any Race)
Lincoln	97.1	0.1	0.6	0.2	0.1	0.7	1.2	2.2
Sublette	97.5	0.2	0.5	0.2	0.1	0.5	1	1.9
Sweetwater	91.6	0.7	1.0	0.6	0.0	3.6	2.4	9.4
Wyoming	92.1	0.8	2.3	0.6	0.1	2.5	1.8	6.4

Note: Percentages may not add to 100 because individuals may report ethnicity under more than one category.
Source: U.S. Bureau of Census.

Population in Poverty

The poverty level is often used as a determination of low-income status. The U.S. Census Bureau estimates poverty levels using a set of money income thresholds that vary by family size and composition. If a household's income is below the money threshold, the family and all the individuals of that household are considered to be in poverty. Using this criterion, the Census Bureau provides estimates of

the percentage of individuals that fall below the poverty level for each county in the United States. Poverty estimates also are provided not only for the various regions of the United States but also for the United States as a whole.

Table 3-48 summarizes the estimated poverty rates for the three counties in the socioeconomic study area, Wyoming, and the United States. For the three counties, estimated poverty rates during the past decade have been below the state and national averages. The median household income (Map 3-9) in Lincoln, Sublette, and Sweetwater counties is above the state average, and poverty rates are lower than statewide poverty rates. This indicates the absence of low-income populations on a countywide basis for the three counties that could be affected by BLM actions within the planning area, even though small groups of low-income individuals may still be present and potentially affected.

Table 3-48. Estimated Poverty Rates in the Socioeconomic Study Area

Location	1989	2002
Lincoln County	9.8%	9.1%
Sublette County	8.4%	7.3%
Sweetwater County	8.0%	7.9%
Wyoming	11.9%	10.6%
United States	12.8%	12.1%

Source: U.S. Census Bureau, State Model Estimates of the Percentage of Persons of All Ages in Poverty.

3.10.9 Community Attitudes and Beliefs

Social characteristics throughout the planning area are similar to those in other small, rural western communities. These areas are strongly tied to traditional natural resource-based industries such as agriculture and extractive industries. Public lands are important in providing a natural resource base for economic activities and supporting a particular lifestyle. Public lands also provide scenic beauty, wildlife habitat, and world-class recreational opportunities. Because public lands compose much of the land area in the socioeconomic study area, management decisions can affect the economic base of local communities and the lifestyles to which these local communities are tied.

Although agricultural activities have decreased in economic importance in recent years in the socioeconomic study area, the agriculture industry remains very important for its historic and cultural influences. Because the management decisions of the planning area affect ranching operations beyond public land boundaries, communities are concerned about the social influences these decisions can have on local communities.

The oil and gas industry has also played an important role in the social character of the socioeconomic study area. This industry has been an important part of the tax base for all three counties for nearly 50 years. The area has experienced several boom and bust cycles throughout its history, but there is now an increased population tied to this industry. These individuals are active members of local communities and directly affected by management decisions made by the PFO.

Despite the traditional social characteristics throughout the planning area, indications are that these views and beliefs are changing somewhat. Between 1990 and 2000, the socioeconomic study area experienced an increase in investment income—46% across the study area. This was likely from retirees, remote working professionals, and second homeowners attracted to this region for the abundant and high-quality air, water, and land resources that offer a rich quality of life and a western wilderness heritage. However, more recent data indicate that this type of income is decreasing in the study area—down 19% between 2000 and 2006. It is likely that the current boom in gas development and production in the area is deterring the relocation of retirees and second homeowners.

Two information sources were consulted and summarized to portray some of the social issues and public perspectives surrounding increasing development in Pinedale and Sublette County. The first source, described in the next section, is a report that summarizes qualitative Sublette County resident interviews and survey results concerning sustainable development and the inherent trade-offs between development and preservation. The second source is a summary of two public meetings that occurred in Pinedale as part of *A Wyoming Conversation*. The two topics that were discussed in these meetings were the shifting economy and perspectives on newcomers to the area.

Current Public Perspectives on Sustainable Development in Sublette County

Students from Rice University in Texas recently undertook a study of Wyoming's Sublette County, assessing public perception and opinions about gas exploration and production and other types of development with respect to environmental preservation between June and December 2004 (Gelman and Lacouture 2005). They conducted a survey of Sublette County and a national survey, conducted stakeholder interviews, and researched archival data. The mail survey of Sublette County received 650 responses, and the researchers conducted many stakeholder interviews with employees of gas companies, representatives of gas companies, representatives of conservation and environmental groups, government leaders, ranchers, and residents of Pinedale.

When the residents of Sublette County were asked about their perceptions of the importance of various attributes of the environment and development, they felt that environmental concerns were more important (i.e., clean lakes and streams, clean air, and maintenance of stable wildlife populations) than having an adequate supply of natural gas. Pinedale attitudes toward preservation and development were compared with national views as well. Interviews revealed that many residents were concerned about visual disturbances and noise pollution associated with gas drilling on the Pinedale Anticline. When asked to choose between environmental concerns and both residential and gas development concerns, the residents of Sublette County favored a balance of development and environmental presentation, although the responses were skewed toward less development and more wildlife preservation (Figure 3-42). It is important to note that residential development was perceived as just as potentially harmful to the environment as is oil and gas development. The national public is more apt to preserve wildlife even at the expense of limiting energy development (i.e., the national public is more environmental preservation-focused).

The Pinedale Anticline area is considered crucial habitat for the sage-grouse as well as Pinedale's larger migratory animal residents. Therefore, drilling has been restricted on critical winter ranges from November 15 through April 30. Recently, Questar has been allowed to drill in the winter. Economically, the winter moratorium on new drilling could have been causing a seasonal boom-and-bust cycle in the economy of Pinedale. During the summer months when most of the gas operations occur, restaurant and other tourist service industries faced a shortage of workers, because some were taking the higher-paying gas industry jobs. Because the tourism industry is increasing in this area, the summer boom months will continue if there is less gas development. However, the increasing summer gas development is exacerbating the seasonal stresses on the infrastructure and other supporting services. It is apparent that safety is compromised with the fast ramping up and down of the rigs twice a year. For example, six oil and gas workers have been killed on the job (Personal Communication, Roy Allen, October 2006). Seasonal increases in crime and the danger of well sites ramping up and down quickly will likely continue if 6-month drilling schedules continue (Gelman and Lacouture 2005).

There are many popular recreational activities in Sublette County, including hunting, fishing, OHV riding, camping, mountain biking, and snowmobiling. Figure 3-43 demonstrates the types of recreational activities that county residents enjoy, as well as their related expenditures and concern about potential negative impacts on these activities. Residents are concerned that public land, which functions to provide multiple uses to all inhabitants, becomes single use with the onset of a gas drilling lease (Gelman and Lacouture 2005).

The authors conclude with some suggestions from their sociology research, interviews, and surveys of Sublette County residents (Gelman and Lacouture 2005):

One of the most debated topics in Pinedale is directional drilling, particularity on crucial winter-range habitat. Although more costly than traditional vertical drilling, directional drilling would decrease the amount of land fragmentation and surface disturbances by allowing multiple wells to be drilled from a single pad. It would lessen traffic, thereby decreasing noise and air pollution because multiple wells could be serviced from one location. If directional drilling were implemented, it is possible that WGFD would permit gas companies to drill year-round. That dramatic change in the drilling schedule would have a major effect not only on the gas companies, but also on Sublette County.

A benefit from the institution of year-round drilling would be the increase in safety for gas company employees and contractors. There would be less rushed ramping up and down of rigs twice a year to abide by the moratorium on drilling. In addition, new workers would not have to be trained each year because year-round drilling would bring employee stability. Workers would be able to spend more time in the community and with their families. A decrease in crime might be observed. Year-round employees would likely to be more committed to protecting wildlife and to other issues than short-term employees. The increase in year-round workers would likely cause growth in the town of Pinedale, but the growth could bring greater social and economic stability. Year-round drilling could also have negative implications for wildlife during sensitive seasons such as migration and mating, and it might also further contribute to air quality degradation and groundwater contamination.

In conclusion, the report indicates that with the dramatic increase in gas production in Sublette County during the past decade, many residents were concerned about environment and wildlife preservation. However, they were aware that it was beneficial to continue and possibly increase gas development, and they were not looking to cease gas development to keep the environment undisturbed. Rather, residents wanted to see a balance between development and preservation of the environment. The survey indicates, as well, that the residents of Sublette County were more apt to support both development and environmental protection, whereas the national public might in some instances prefer wildlife protection to gas development if the development were shown to significantly hinder wildlife populations.

Pinedale Public Perspectives on the Shifting Economy and Newcomers

In January and February 2005, two meetings were held to discuss "A Shifting Economy" and "Newcomers and Wyomingites" with people who live in Pinedale as part of *A Wyoming Conversation,* a statewide discussion program in partnership with Wyoming Public Radio, Wyoming Public Television, the Wyoming Community Foundation, and the University of Wyoming American Studies Program. Both discussions were facilitated by Mary Lynn Worl. More information is available at the following website: http://www.uwyo.edu/wch/AWC_Pinedale.htm.

The first discussion, A Shifting Economy, brought together 34 people from the Pinedale area, including the mayor, ranchers, gas industry employees, realtors, recreational outfitters, and retirees. One major point of the discussions was that Pinedale had always been one of the most economically diverse western towns, with agriculture, timber, recreation, and drilling. Throughout the discussion, participants stated that sustaining this diversity was important to ensuring that one industry did not jeopardize the others. Both logging and agriculture were declining, while tourism and gas production were on the increase. There was concern within this group about maintaining the area's culture and heritage in the face of such rapid growth. Most of the discussion of the oil and gas industry focused on the social impacts of growth, particularly in the areas of housing and the increasing demand for social services, police, and so forth.

The second discussion, Newcomers and Wyomingites, included 14 people from varied backgrounds and occupations, including retirees, business people, the mayor, fine arts council members, and ranchers. A majority of the people had lived in the area for more than 20 years; six people had been in the area for 10 years or less, and only one for less than 4 years. Newcomers to the area were considered second

homeowners, retirees, and gas field workers. Participants rated Pinedale as generally unfriendly toward newcomers. Perceptions were expressed that Pinedale had experienced considerable growth in the number of new people in a very short period. Although the group felt that new people brought new ideas and blood to a community, they also felt that the rapid change could create fears of how the growth would affect the town. Established residents expressed a reluctance to get close to gas field workers who came during the boom because they might leave when the bust came. There was some resentment toward newcomer complaints that the town lacked amenities such as shopping and high-speed Internet. The group felt that there should be more ways to reach out to newcomers to involve them with and integrate them into the community.

3.11 SOILS

Soils of the planning area have formed from a wide variety of geologic material, ranging from in situ geologic parent material rock (residuum) to material transported by wind (aeolian deposits), water (alluvium), gravity (colluvium), and ice (glacial till). These parent materials, along with variable climate, topography, vegetation, and management, produce soils with diverse characteristics.

3.11.1 Soil Groups

Geomorphic Group I—Soils of the Mountains

Geomorphic Group I soils are located along the northeast and western borders of the planning area and make up 20% of the total area. Parent materials include residuum from sedimentary and igneous rock, colluvium from landslides and earthflow, and alluvium in fans and drainages. Glacial till occurs along the Wind River Front. Slopes range from gently sloping to very steep (3% to 70%) with very shallow to deep gravelly, loamy, and clayey soils predominating. Coniferous vegetation and aspen are often present on the north-facing slopes that receive greater effective precipitation, resulting in higher productivity and organic matter enrichment. The steep slopes, short growing season, and high landslide potentials limit management opportunities in these areas.

Geomorphic Group II—Soils of the Foothills

Geomorphic Group II soils are located in the northwest central and southwest central portions of the planning area and make up 13% of the total area. Dominant parent materials consist of residuum formed over upthrusted sediments, colluvium in the form of landslide and earthflow deposits, and alluvium on footslopes and drainages. The shallow to moderately deep, well-drained soils are found in rolling to steep (6% to 60% slope) topography. Geologic overthrusting and resulting mixed exposures (parent materials) have produced variable soil textures and very complex soil/landform relationships. Opportunities to mitigate adverse impacts on soils are limited by the dominance of shallow soils, low precipitation, and moderate to high landslide potential.

Geomorphic Group III—Piedmonts and Alluvial Fans

Geomorphic Group III soils are found in the central western portion and along the mountains on the northeast edge of the planning area. The soils make up 19% of the total area. Alluvial parent materials on the terraces, fans, and piedmonts have formed soils on nearly level to moderately steep (0% to 30%) slopes. Generally, features are well-drained, gravelly and cobbly sandy loams. Limited management features include occasional steep slopes coupled with alkaline areas in alluvium and cobbly surfaces in glacial moraines.

Geomorphic Group IV—Soils of the Uplands

Geomorphic Group IV soils dominate the central and southeast half of the planning area. Upland soils make up 34% of the total area. Residuum found over flat-lying sediments, dune-like aeolian deposits, and alluvium from the uplands are most prominent. Generally, soils are alkaline, ranging from shallow to deep on nearly level to very steep (0% to 70%) slopes. Although usually well-drained, areas of shale uplands and badlands have clayey textures and salinity problems resulting in poor availability of moisture to plants. The Yellow Point sand dune areas have sandy and loamy soils that are excessively drained and have little water-holding capacity. The combination of low precipitation, salinity, and excessively drained soils limits opportunities to mitigate impacts on soils. Generally, the soils of this group in the basins are formed in shales producing clayey textures, poor infiltration, high runoff, and high potential for slumping.

Geomorphic Group V—Soils of the Flood Plains

Geomorphic Group V soils are associated with major drainages and are found throughout the central portion of the planning area. These soils make up 14% of the total area. These nearly level to rolling (0% to 10% slopes) soils are generally deep, variable in texture, and derived from alluvium. Although usually productive, areas of saline-alkaline-affected soils limit vegetation production (USDI, BLM 1997b).

3.11.2 Soil Conditions and Characteristics

The soils in the planning area possess several limitations that reduce the potential for establishing vegetation following a disturbance. Soils with limitations include highly erodible, saline, sodic, and sandy soils. Soils considered susceptible to these limiting features are discussed in the following subsections.

Highly Erodible Soils

Highly erodible soils are characterized by the loss of valuable topsoil resulting from action by either wind or water. Erosion increases when the vegetative community is disturbed by intense grazing, fire, road construction, or any other use that reduces the amount of vegetative cover.

Several soils in the planning area are red and have a history of erodibility when disturbed—Almy, Chedsey, Cundick, Eighteen, Iyers, Jerry, Kismet, Nineteen, Redhill, and Stovho soil series. The Forelle soil is not red, but it is considered highly erodible.

Saline Soils

Saline soils have calcium, magnesium, or other nonsodium salts dominating their ionic composition, although they might also contain some sodium salts. Soil salinity can have significant effects on soil erosion and reclamation potential. Because erosion of saline soils can also have significant effects on downstream water quality, saline soils are managed to minimize impacts in these areas and to promote the revegetation of previously disturbed areas to the greatest extent possible. Cambarge, Chrisman, Dines, Fluvents-saline, Laney, Mone-saline, Sandbranch, and Tresano variants are some of the soils in the area that have high salt contents (USDI, BLM 2002b; USDI, BLM 1990c).

Sodic Soils

The ionic composition of sodic soils is dominated by sodium salts. Soils with sodium adsorption ratios (SAR) of 13 or greater are considered sodic. Infiltration of precipitation into these soils is reduced by the dispersion of soil particles caused by the higher levels of sodium. Reduced infiltration rates result in greater surface runoff rates and increased soil erosion and sediment yields. Many of these soils have a thin layer of less sodic soil above the sodic horizon; therefore, when this layer is disturbed or removed, the resulting impact can be irreversible. Soil series in the planning area with SAR values in excess of 13 include Blazon, Bosler, Bodorumpe Charlos variant, Coalmount, Cora, Dinnen, Foxcreek, Gelkie, Edlin, Haterton, Heath, Laney, Littsan, Millerlake, Maurice, Paulson, Rickman, Tineman, and Westvaco (USDI, BLM 2002b; USDI, BLM 1990c).

Sandy Soils and Sand Dunes

Sandy soils are highly susceptible to wind erosion, and efforts are made to avoid disturbing these areas. Sandy soil series include Crestman, Eightyfive A-B-C, Koonich variant, LaMarsh, Littsan variant, Ryan Park, and Space City (USDI, BLM 1990c).

Limitations on Specific Activities

With the exception of hard-surface, all-weather roads, most roads in the planning area are constructed

from local soils or improved with gravel. Soil properties that are limiting to construction of roads in the area include sodium content, gypsum content, soluble salts, low strength, high shrink-swell potential, and susceptibility to frost action. The content of large stones, depth to hard bedrock, and slope are also important physical features that are considered when determining the suitability of soils for road construction. The fragile nature of native soil surface and biological crusts, especially in areas in which erosion control and revegetation are difficult, can limit the appropriateness of off-road uses, as can soil features such as clayey soils, salinity, sodium content, slope, water erosion, and depth to saturated soils. Refer to Section 3.12.3 for further discussion of off-road uses.

Many soils within the planning area have limiting features that make reclamation and revegetation difficult. These limiting features include salinity, sodium content, clayey and sandy textures, droughty conditions, alkalinity, low organic matter content, shallow depth to bedrock, stones and cobbles, and wind erosion. Sometimes the soil limitations are so severe that reclamation is very difficult after disturbance.

3.12 TRANSPORTATION, ACCESS, AND TRAVEL MANAGEMENT

Transportation activity within the planning area is associated with recreational and nonrecreational use of the land. This section describes the current transportation and access structure of this area.

3.12.1 Basic Transportation Structure

US Highways 191 and 189 traverse the planning area in a north-south direction (Map 3-10). State Highways 235, 350, 351, 352, 353, and 354 are all within the area. State Highway 351 is a major east-west access through the planning area. The road systems for Sublette and Lincoln counties consist of limited paved roads and a network of unpaved roads.

The BLM-managed transportation system is extensive and complements the public road system. These roads are primarily improved dirt roads. Not all of the roads are maintained. Roadways managed by BLM are often used to access private interests. A network of roads built and maintained primarily by the oil and gas industry provides transportation routes across the planning area. Section 9113 of the BLM Manual determines the functional classification of roadways, which also determines design speeds. BLM roads are classified as collector, local, and resource roads, as described below:

- **Collector Roads.** These roads normally provide primary access to large blocks of land and connect with or are extensions of the public road system. Collector roads accommodate mixed traffic and serve many uses. Within the BLM-managed system, collector roads carry the highest volume of traffic.

- **Local Roads.** Normally, these roads serve a smaller area than collector roads and connect to collector roads or public road systems. Local roads carry lower volumes and fewer traffic types, and serve fewer uses. Commonly, local roads in mountainous terrain are single lane.

- **Resource Roads.** Normally, these roads are spur roads that provide point access and connect to local or collector roads. They carry a very low volume and accommodate only one or two types of uses.

Design for these roadways follows the standards set by the American Association of State Highway and Transportation Officials (AASHTO) "Policy on Geometric Design of Highways and Streets." Maintenance is primarily BLM's responsibility; however, some roads are jointly maintained with the USFS.

3.12.2 Access

Access across private land to public lands is a continuing issue within the planning area. BLM's policy is to acquire access only when needs are identified through land use planning as being essential for the management of BLM-administered lands and resources. Needs are ranked with other access needs throughout the State of Wyoming to determine how the limited resources for acquisition are used. Access easements fall into three categories:

- **Perpetual Exclusive**. A perpetual right acquired by the United States to use land of another for a particular purpose, such right being acquired exclusively by the United States and excluding others from enjoying the same privilege unless specifically authorized by the United States.

- **Perpetual Nonexclusive**. A perpetual right acquired by the United States to use land of another for a particular purpose, such right not being granted exclusively to the United States and not excluding others from enjoying the same privilege.

- **Temporary Nonexclusive**. A method similar to perpetual nonexclusive, except that the grant is for a period of time as specified in the conveyance document.

To establish joint agency cooperation when acquiring access to public lands, the BLM has a memorandum of understanding (MOU) with the Wyoming Board of Land Commissioners, USFS, and the WGFD.

3.12.3 Off-Highway Vehicle Use

OHVs include any motorized vehicle capable of travel on or immediately over land or other natural terrain. The varied landscape; large areas of public land with roads and trails open to OHVs; and numerous landforms along the northern, eastern, and western boundaries of the planning area (composed of the foothills and approaches to the Wyoming Range and Wind River Range) provide numerous opportunities for OHV use. This varied landscape and the proximity of and access to the USFS-administered lands in the Bridger-Teton National Forest have contributed to the popularity of this type of vehicle use.

OHV Designations

The three OHV designations within the planning area are open, limited, and closed, as described below:

- **Open.** An area where all types of vehicle use are permitted at all times anywhere within the designated open area, allowing for cross-country travel on and off roads.
- **Limited**—
  - **Existing.** Vehicle travel is permitted only on existing roads and vehicle routes that were in existence before the date of designation in the *Federal Register*.
  - **Designated.** Vehicle travel is permitted only on roads and vehicle routes designated by BLM. In areas where final designation has not been completed, vehicle travel is limited to existing roads and vehicle routes as described above.
  - **Administrative.** Vehicle travel off existing vehicle routes is permitted only to accomplish necessary tasks and only if such travel does not result in resource damage. Random travel from existing vehicle routes is not allowed. Creation of new routes or extensions and/or widening of existing routes is not allowed without prior written agency approval. Seasonal closures also exist in the planning area, which restrict OHV use in certain areas (generally crucial and critical wildlife areas) on a seasonal basis. The dates for these closures vary based on the area and species that they were instituted to protect.
- **Closed.** An area where OHV use is prohibited. Use of OHVs may be allowed for certain reasons, subject to approval by the BLM Authorizing Officer.

OHV designations within the planning area apply to all OHVs, with the exception of non-motorized mechanized vehicles and emergency vehicles, regardless of the purpose for which they are to be used. The designated OHV areas are depicted on Map 2-13.

OHV Use Description

OHVs are used in the area for recreational and nonrecreational use. Recreational OHV use involves activities associated with wood gathering, antler collecting, hunting, sightseeing, and general cross-country travel and trail riding. Much of the nonrecreational OHV use, or administrative use, includes OHVs driven by local ranchers, oil and gas developers, land surveyors, and geological surveyors performing seismographic studies. During the winter months, nonrecreational use includes snowmobile

use for these same activities.

Snowmobiles are a common recreational OHV used in the planning area. However, most recreational snowmobile use occurs on higher-elevation USFS-administered lands. The use season on BLM-administered lands runs from about December through April. The eastern side of the planning area, along the lower slopes of the Wind River Range, has a segment of the Continental Divide Snowmobile Trail system that provides opportunities for spectacular, scenic views of the surrounding mountains and dense forests. To the west, many access points to the Wyoming Range also provide OHV recreational opportunities for viewing scenery and enjoying deep snow. Motorcycles and all-terrain vehicles (ATV) designed for high speeds and racing use are becoming more popular in the area, but the use season is fairly short, running from May through September (USDI, BLM 1988; Wyoming Department of State Parks 2002).

OHV Use Trends

The majority of OHV use within the boundaries of the planning area takes place on existing roads and trails. OHV use appears to have increased in some areas during the past 15 years as is evidenced by the expansion of trails by ATVs and motorcycles. Some localized trail expansion is related to the growth in use by racing-type ATVs and motorcycles. The current demand for general OHV use is not exceeding the capacity of areas open to OHV use.

As identified in *BLM's National Management Strategy for Motorized Off-Highway Vehicle Use on Public Lands* (USDI, BLM 2001), the growth in OHV use can be attributed to the following:

- Greater public interest in unconfined, outdoor recreational opportunities
- Rise in the amount of disposable income, fostered by a healthy domestic economy, for use in recreational pursuits
- Advances in vehicle technology that enable motorized OHV users to reach previously inaccessible areas
- Rapid expansion and population growth of cities and suburbs in the western states, which has brought westerners closer to once-remote public lands
- Population with an increasing median age and changing outdoor recreational interests.

It is difficult to estimate the degree to which road expansion from OHV use will take place in the future, but roads and trails now extend to most areas of interest. Roads and trails on BLM-administered lands are frequently used as transportation routes to access USFS-administered lands. The Irish Canyon access to the Bridger National Forest is becoming extremely popular for snowmobile use because the route is part of the Continental Divide Snowmobile Trail System and extends into the Bridger-Teton National Forest (Hudson 2002). OHV use for antler collecting has become increasingly popular in the past decade. In addition to these uses, interest in developed mountain bike and motorized OHV routes has increased.

OHV Use/Resource Conflicts

Increased OHV use during the past 10 to 15 years has created some identifiable concerns with the management of OHV activities. The most notable concern may be the occurrence of OHV use in some areas in which repeated motorized travel on erodible soils and/or steep slopes may be causing degradation of water quality, loss of vegetation, and alteration of the visual landscape. Another identified concern is the effect of motorized activities on wildlife in crucial winter habitat.

Areas in the planning area that experience high levels of OHV use are as follows:

- The east side of the Wyoming Range in the vicinity of Red Canyon, Miller Mountain, Bald Mountain, and South Muddy Creek where hunting-related OHV use is creating trails on erodible soils and near riparian areas, and is degrading visual quality
- The Blue Rim area in the Desert General Open Area where OHV use conflicts with resource values in an area containing sensitive resources that may be vulnerable to degradation
- Portions along the south and western slopes of the Wind River Range where the creation of trails is degrading visual quality
- Ridgetops in areas that are heavily hunted and where multiple trails have been created by hunters driving up to look over the edge for game
- Near the communities of Big Piney-Marbleton and Pinedale where the creation of trails on erodible soils is causing visual impacts and contributing to soil erosion
- Throughout the planning area in areas of intensive or important seasonal use by wildlife.

OHV Noise Considerations

OHV noise can be considered intrusive and unpleasant to other recreational users. Areas of vehicle use in the planning area range from WSAs and sparsely populated rural areas to more densely populated small urban communities and highways. In WSAs, expected ambient sound levels would typically be about 30 to 40 decibels (dB). Small urban communities away from main highways and county roads experience outdoor sound levels that are typically lower than 50 dB (Cunniff 1977, Harris 1991). An approximate noise level range for the more popular brands of OHVs is between 80 and 108 dB (Oregon Off-Highway Vehicle Association [OOHVA] 2002). Approximate examples of other common sound levels are as follows: a bedroom at night, 30 dB; a residential area at night, 40 dB; a typical office, 50 dB; conversational speech, 60 dB; a vacuum cleaner at a distance of 6 feet, 70 dB; a concrete mixer at a distance of 50 feet, 80 dB; and a jackhammer at a distance of 50 feet, 100 dB (Bell 1973, Cunniff 1977, Harris 1991).

3.13 VEGETATION

The planning area lies in a high-elevation, cold-desert ecosystem. Bailey's coercion classification identifies two provinces within the planning area (Bailey 1995). Roughly the eastern two-thirds of the planning area is within the intermountain semidesert province. It consists of plains at elevations of 6,000 to 8,000 feet, with isolated hills and low mountains up to 2,000 feet higher. This area includes the Wyoming Basin, which typically has cold winters and short summers. Most of the vegetation is described as sagebrush steppe (Bailey 1995). The remainder of the planning area is within the southern Rocky Mountain steppe-open woodland-coniferous forest-alpine meadow province of the middle and southern Rocky Mountains. High-elevation plateaus and mountain slopes characterize this ecoregion. Prevailing west winds influence the climate, and east slopes are more arid than west slopes. A variety of vegetation communities are found within this province and are determined by elevation, slope aspect, and climate (Bailey 1995). Common vegetation communities are big sagebrush, aspen woodlands, and conifer communities.

Vegetation change over time is available from the University of Wyoming's Normalized Difference Vegetation Index (NDVI). These data are a result of comparisons between Landsat Multi-Spectral Scanner images from the 1970s, 1980s, and 1990s that emphasize differences between green vegetation and bare soil. During the 20-year period of analysis, there has been minimal change over most of the planning area. Few areas show a noticeable increase in vegetation, whereas some areas along tributaries to the Green River show a decrease in vegetation and an increase in bare soil.

The source of vegetation community information in the planning area is the University of Wyoming's Gap Analysis Program (GAP) vegetation analysis data and land cover. The GAP land cover is a result of interpretation of Landsat Thematic Mapper imagery (1994). Some other sources of land cover are available for portions of the planning area, but the GAP data are used in this document because of their comprehensive coverage of the area. Appendix 23 contains scientific names of plant species.

3.13.1 General Vegetation

Most of the planning area is dominated by sagebrush and mountain shrub communities, with some riparian-, saltbush-, and woodland-dominated areas. Vegetative composition is a function of climate, aspect, elevation, soils, and disturbance variations. Vegetation zones mapped using combinations of the GAP analysis plant communities include riparian/wetland, grasslands, big sagebrush, other shrub, aspen woodlands, lodgepole pine, other conifer, and barren (Map 3-11). In addition, open water and areas of human impact, such as urban and settlement areas and cropland, are mapped. Table 3-49 displays the BLM surface acreage of cover for each mapped vegetation zone. Acreage of timbered vegetation types differs between the GAP data and the Stage II forest inventory data used in Section 3.4. The reason is that (1) the two data sets were collected using different scales and different levels of accuracy, and (2) the GAP data include lands of all ownerships, not just public lands, in the planning area. For this analysis, the forest and woodland information uses the Stage II inventories.

Table 3-49. Acreage of Vegetation Communities Within the Planning Area

Vegetation Community	Vegetation Type	Acreage
Big sagebrush	Wyoming big sagebrush	645,476
	Mountain big sagebrush	99,177
Other shrub	Desert shrub	57,527
	Greasewood	4,216
Aspen forest	Aspen forest	30,165
Lodgepole pine	Lodgepole pine	30,413

Vegetation Community	Vegetation Type	Acreage
Other conifer	Limber pine	9,238
	Douglas fir	7
	Spruce-fir	128
Riparian/wetland	Shrub-dominated riparian	3,515
	Forest-dominated riparian	2,308
	Graminoid/forb-dominated wetland	1
Open water	Open water	130
Grasslands	Mixed grasslands	4,435
	Subalpine meadow	310
Human impact	Irrigated crops	28,278
	Dryland crops	2,668
	Agricultural/urban	30,946
Barren	Barren	4,759
Total		**922,880**

Riparian and Wetland Communities

Riparian and wetland communities are the transition zones between terrestrial and aquatic ecosystems (Gregory et al. 1991). These communities are found in moist areas along perennial or intermittent drainages, seeps, and springs. Typically, soils consist of deep, rich loams with high amounts of organic matter. Because of the high productivity of riparian areas, they are very important resources for wildlife and livestock. The lush vegetation in riparian communities provides valuable food and cover; if water is present, the importance of these areas increases even more.

Within the planning area, riparian/wetland vegetation types include riparian forest, shrubland, and herbaceous meadow/wetland areas. Together, these three vegetation types make up roughly 5,824 acres within the planning area. These categories are mapped as a single zone on Map 3-11 and are individually described in more detail in the following subsections.

Riparian habitat throughout the planning area was assessed for PFC following methodologies described in BLM technical references 1737-15 and 1737-16. The assessment was conducted between 1994 and 2001. The results are summarized in Table 3-, p. 3-34.

Forest- and Shrub-Dominated Riparian Communities

Riparian forest communities in the planning area are dominated by narrow-leaf cottonwood, with an understory of shrub, forb, and grass species. These communities cover approximately 2,308 acres within the planning area.

Shrub-dominated riparian communities consist of high densities of various willow species, with an understory of grasses, sedges, and forbs. These communities cover approximately 3,515 acres within the planning area.

Wetland Communities

Wetland communities include moist meadow communities dominated by herbaceous riparian and/or wetland species. Wetland communities comprise about 1 acre of the planning area. They occur in areas of high moisture (e.g., near springs or seeps), supporting wetland herbaceous vegetation.

Grassland Communities

Grasslands are found primarily in the western portion of the planning area along shallow ridges of the Overthrust Belt (USDI, BLM 1985) and cover approximately 4,745 acres within the planning area. Patches of grasslands are found scattered throughout low- and high-density sagebrush communities. These grassland communities provide important habitat and forage for wildlife. Grass species dominate these communities, but shrubs, subshrubs, and cushion plants are also common. Included within the grassland mapping zone is a small area (310 acres) of subalpine meadow in the western portion of the planning area.

Sagebrush Communities

Sagebrush communities are the most extensive plant cover type, not only in the planning area but also in the surrounding Wyoming Basin area and intermountain region. Sagebrush communities cover approximately 744,653 acres within the planning area. Adaptations to different habitat characteristics (e.g., soil type, climate, and elevation) have resulted in a variety of sagebrush species in the western United States (Monsen and Shaw 2000). Sagebrush communities in the planning area are dominated by two subspecies of big sagebrush (Wyoming big sagebrush and mountain big sagebrush), with a well-established grass and forb component.

Native sagebrush communities across the West have been altered by changes to the natural fire regime and disturbances, such as herbicides, cultivation, excessive grazing, and insect activity (USDI, BLM 1989). European settlement and impacts in sagebrush-dominated regions brought about changes in many of these areas, including an increase in sagebrush density, introduction of non-native species, and reduced numbers of certain native grasses and forbs (Tisdale and Hironaka 1981). More recently, mineral development and urbanization have impacted sagebrush communities. Although the species composition of these communities may have changed somewhat since European settlement, these rangelands are still dominated by native plant communities. A majority of the species that were present in historic plant communities are still present today.

Overgrazing by livestock tends to deplete sagebrush communities of their native grass and forb element, resulting in increases in density of sagebrush or, alternatively, invasion of exotic weedy species (USDI, BLM 1999). Within the planning area, grazing has resulted in increases in the density of sagebrush and some changes in the herbaceous plant communities. No widespread invasions involving exotic weedy species that dominate the native plant communities have been observed. Wildland fires in sagebrush communities have increased in number and intensity compared with historical levels in some parts of the West, but that has not been a particular issue in the planning area.

Wyoming Big Sagebrush

Wyoming big sagebrush is the most xeric of the big sagebrush varieties in the planning area. Within the planning area, Wyoming big sagebrush communities are found at elevations of 7,000 to 7,500 feet. A canopy cover of sagebrush in high-density areas is typically greater than 35%. Wyoming big sagebrush covers approximately 645,476 acres within the planning area. Species commonly associated with Wyoming big sagebrush include various other shrubs, grasses, and forbs, such as rabbitbrush, Letterman's needlegrass, thickspike wheatgrass, various bluegrass species, phlox, and buckwheat.

Mountain Big Sagebrush

Mountain big sagebrush usually grows above elevations of 7,800 feet in portions of the planning area that receive annual precipitation amounts of 15 inches or more. This translates to approximately 99,177 acres within the planning area. The same understory species typically occur in the mountain big sagebrush as occur in the Wyoming big sagebrush communities, with the addition of fescues and other species of wheatgrasses. In addition, the understory is generally more productive in this type because of a greater

amount of precipitation.

Low-Density Sagebrush Communities

Low-density sagebrush communities are found in basins and are characterized by shrub canopy cover of less than 35%. Various species of sagebrush may dominate, including basin big sagebrush, black sagebrush, alkali sagebrush, and three-tip sagebrush. In low-density areas dominated by Wyoming big sagebrush, associated species are similar to those for Wyoming big sagebrush communities. Additional common species associated with Wyoming big sagebrush in low-density areas include Sandberg bluegrass, Indian ricegrass, and horsebrushes. Also included in the low-density sagebrush classification are low-growing sagebrush communities found on dry, windy ridges and/or areas with shallow soil. Low-density sagebrush communities are mapped with other sagebrush communities on Map 3-11.

Mountain Shrub Communities

Mountain shrub communities include dominant shrub vegetation other than sagebrush, such as antelope bitterbrush, true mountain mahogany, serviceberry, and snowberry. These communities are found within sagebrush communities in areas that receive additional moisture from snowbanks, seeps, and springs (USDI, BLM 1986a). The sagebrush communities within the glacial deposits on the east side of the planning area are characterized by a high percentage of bitterbush and are significant vegetation zones for mule deer in spring and fall. Common associated species of mountain shrub communities are similar to those of mountain big sagebrush communities. On Map 3-11, mountain shrub communities are mapped with big sagebrush.

Salt Desert Shrub

Salt desert shrub communities are composed primarily of saltbush and greasewood communities (Map 3-11). Saltbush communities occur as typical saltbush communities and as half-shrub communities. Typical saltbush communities are usually found on soils with high salt or exchangeable sodium content, including badland clay soils, colluvial deposits, and alluvial outwashes. Salt-tolerant species inhabit these areas, and Gardner's saltbush is usually dominant (USDI, BLM 1986a). Their grass and forb component is similar to that for the sagebrush community, with Indian ricegrass often the dominant grass (USDI, BLM 1986a). Half-shrub communities consist of shallow-rooted, salt-tolerant species (e.g., bud sagebrush, winterfat, and buckwheats), Gardner's saltbush, low rabbitbrush, spineless horsebrush, rhizomatous wheatgrass, and squirreltail. Soils tend to be heavy clay with slow permeability, sometimes shallow with shale bedrock in basins and flatlands (USDI, BLM 1986a). Saltbush communities provide wildlife and livestock forage. However, their management and manipulation are strongly limited by climate and soils and are undertaken only after thorough analyses of community health, structure, and potential (USDI, BLM 1986a). Greasewood communities are found in basins in heavy, dense alkaline soils or on the west side of the Green River in upland areas with neutral to alkaline sandy clay soils. Generally, these communities are not valuable for forage because of the low productivity associated with the alkaline soil.

Woodland Communities

Forest and woodland communities consist of broadleaf species, including aspen stands, cottonwood, and willow, and at higher elevations, whitebark pine and limber pine association. Cottonwood and willow communities are described in the previous discussion of riparian communities. Aspen stands occur in areas with high moisture availability such as on northern and eastern exposures where snow packs accumulate. They often occur on the edges of conifer stands as a transition between sagebrush and conifer zones.

Aspen Woodlands

Aspen woodlands are important forage areas for wildlife and livestock. These communities also have

recreational value for scenery, camping, and hunting. Overgrazing of these communities can lead to depletion of the understory component, resulting in a decrease in forage value. Aspen stands have evolved with fire as a regular occurrence. Aspen stands cover approximately 15,198 acres in the Field Office. The understory component of aspen stands includes a mix of shrubs, grasses, and forbs, such as snowberry, creeping juniper, kingspike fescue, Idaho fescue, bluebunch wheatgrass, various bluegrass and needlegrass species, as well as Oregon grape and lupine. Aspen stands in the Pinedale area are normally even-aged stands that originated from a single top-killing event. An aspen stand consists of clones, with the stems of that clone being connected. These clones can be thousands of years old and normally cover 1+ acre per clone. Aspen is a very shade intolerant species with a short lifespan, normally from 60 to 150 years. Disturbance, historically from fire, is necessary to maintain the stands. Research has indicated that fire return intervals of 20 to 130 years are necessary. Without disturbance, both shade tolerant conifers and sagebrush establish in the stand, and eventually the clone dies because there is not enough sunlight for the clone to sprout. Without some type of disturbance (fire or mechanical) to encourage new trees, aspen stands eventually die out and are often replaced by conifer communities (DeByle 1985). Overstory removal is normally required for adequate re-sprouting. Aspen falls into Fire Regime IV, and to a lesser extent, Fire Regime II. The Biophysical Setting (BpS) is the Rocky Mountain Aspen Forest and Woodland (LANDFIRE database from www.LANDFIRE.gov).

High Elevation Limber and Whitebark Pine Woodlands

Although limited in size, this vegetation type is important for wildlife because of the nutritious, fleshy seeds. This is one of the most threatened forest/woodland types in the West due to the lack of fire and encroachment by other conifer species (primarily subalpine fire) and disease outbreaks primarily white pine blister rust. Limber and Whitebark pine occurs in the Absaroka, Teton, and Wind River ranges. Grouse whortleberry, heartleaf arnica (*Arnica cordifolia*), Ross' sedge, and Wheeler's bluegrass (*Poa wheeleri*) are common dominant understory components; common juniper and russet buffaloberry (*Shepherdia canadensis*) are occasional dominants.

This conifer woodland is threatened by 1) white pine blister rust and 2) encroachment from subalpine fir because of the interruption of normal fire return intervals.

Limber and whitebark pine ecosystems have a mixed-severity fire regime of widely ranging fire intensities and frequencies. Mixed-severity fires create complex landscapes of dead whitebark pine stands intermingled with live stands of different ages. The fire regime of whitebark pine is Fire Regime III. The BpS is the Rocky Mountain Subalpine—Montane Limber-Bristlecone Pine Woodland (LANDFIRE database from www.LANDFIRE.gov).

Forest Communities

The western, northern, and eastern edges of the planning area contain conifer communities. Lower-elevation forest communities are found on northern and eastern slopes, whereas higher-elevation communities are more extensive and are found on all slopes (USDI, BLM 1986a). The forest communities contain several vegetation types, including lodgepole pine, subalpine fir, Douglas fir, and Engelmann spruce. Dominant conifer species are an indication of elevation, slope aspect, soil characteristics, and climate. For this document, discussion of conifer communities is divided into two sections: lodgepole pine communities and “other conifer” communities.

Lodgepole Pine

Lodgepole pine is one of the most important commercial species in this area. The average lifespan of Rocky Mountain lodgepole pine is 150 to 200 years. Lodgepole pine often occurs in dense, pure stands with little understory. As the stand ages, shade-tolerant conifer species (e.g., spruce and fir) become established in the understory. Historically, fires would be stand-replacing events. Lodgepole is dependent on fire for regeneration. Cones often retain seeds until fire or cutting causes opening and dispersal of

seeds, and lodgepole are often the first trees to become established after fires (USDI, BLM 1989). If fire does not occur, the stand may become dominated by shade-tolerant conifer species such as subalpine fir and Engelmann spruce.

In addition to providing timber, an economic resource, lodgepole forests are valuable as cover for wildlife such as elk. Lodgepole forests cover approximately 10,336 acres on BLM lands and make up approximately 2.6% of the area.

Lodgepole pine is generally a Fire Regime IV with inclusions of Fire Regime V. The BpS is Rocky Mountain Lodgepole Pine Forest (LANDFIRE database from www.LANDFIRE.gov).

Douglas Fir

Douglas fir is an important commercial species in this area and generally occurs with other conifers, primarily lodgepole pine, Engelmann spruce, and subalpine fir. There is approximately 12,600 acres of this vegetation type in the PFO. The GAP data greatly underestimates the Douglas fir, with most of the acres included in other forest types. Douglas fir is the most likely to be found dominating on its own in stands with an understory of bunchgrasses in drier areas or shrubs, grasses, and forbs in more mesic zones.

Understory species include whitestem gooseberry (*Ribes inerme* var. *klamathense*), common juniper, mountain snowberry, spike fescue (*Leucopoa kingii*), bluegrasses (*Poa* spp.), heartleaf arnica, northern bedstraw, oxford ragwort (*Senecio streptanthifolius*), starry Solomon's-seal, Oregon-grape, prickly rose, sheep fescue (*Festuca ovina*), weedy milkvetch (*Astragalus miser*), silvery lupine (*Lupinus argenteus*), Pacific anemone (*Anemone multifida*), arrowleaf balsamroot (*Balsamorhiza sagittata*), rock clematis (*Clematis columbiana* var. *tenuiloba*), fernleaf biscuitroot (*Lomatium dissectum*), and mountain ninebark.

Mature Rocky Mountain Douglas-fir is generally more fire resistant than spruces, true firs, and lodgepole pine. In northwestern Wyoming, cool, dry Rocky Mountain Douglas-fir likely burned every 50 to 100 years. Recent research shows that Fire Regime III is appropriate for this type. The BpS is either the Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland or the Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland, dependent on precipitation (LANDFIRE database from www.LANDFIRE.gov).

Spruce-Fir

Subalpine fir and Englemann spruce are co-dominant species within this type. The whitebark and limber pine association, Douglas fir, and lodgepole pine are also associated with these communities (USDI, BLM 1989). Mixed conifer forests are often dense, with a large amount of accumulated litter and little understory growth (USDI, BLM 1989). Based on GAP data, approximately 10,049 acres, or less than 1% of the planning area, is made up of the “other conifer” vegetation zone, as illustrated on Map 3-11. The Stage II inventory showed 7,787 acres of this forest type on BLM lands.

Engelmann spruce is a valuable commercial species in this area; the other main component in this type, the subalpine fire, is of lesser commercial value. Spruce-fir stands generally do not produce enough forage for livestock but do provide browse and cover for large and small wildlife species. The subalpine fir component is the most susceptible of any of the conifer species in the area to insects and disease.

The spruce and subalpine fir habitat types generally experience high-intensity stand-replacing fires at intervals of 100 years or more. The spruce-fir stands are Fire Regime IV. The BpS for this forest type is either Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland or the Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland, dependent on precipitation (LANDFIRE database from www.LANDFIRE.gov).

Barren Communities

Areas with very little or no vegetative cover include steep slopes, rock outcrops, and badlands, in addition to areas affected by roads and other types of development. Barren communities account for 5,664 acres. As a result of low production of forage or cover, value to wildlife and livestock in these communities is low, although rock outcrop areas do provide nesting and perching habitat for raptors.

Agricultural/Urban Communities

Agricultural areas cover 284,132 acres (17.5%) of the planning area, including irrigated and dryland crops. Most of the agricultural area consists of irrigated hay meadows. Some dryland crops are grown in upland areas away from drainages (5,283 acres). Crops grown on private land in the planning area are dominated by grass hay, such as Garrison creeping foxtail, timothy, and smooth brome, with a few fields of alfalfa throughout the area.

Urban settlements in the planning area account for 732 acres and include the towns of Pinedale, Boulder, and Daniel in the northern portion; Big Piney and Marbleton in the central area; and LaBarge in the southern portion. These locations are combined with croplands as the agricultural/urban zone on Map 3-11. This vegetation cover type can be expected to be entirely on private land that is not subject to BLM management.

3.13.2 Special Status Plant Species

Species with special designations or special management needs (Map 3-12) such as those listed as federally threatened, endangered, proposed, or candidate species or those given other special designations, are known as Special Status Species. These species have an increased risk of extinction because of unique habitat attributes and restricted distribution areas. Consequently, the populations of Special Status Species are of great conservation interest.

The BLM and USFS are among the federal agencies that have adopted policies to protect species designated by the U.S. Fish and Wildlife Service (USFWS) as threatened, endangered, candidate, or proposed under the Endangered Species Act (ESA) of 1973. The BLM and USFS also have their own "sensitive" designation for rare plants that exist within their management areas. In addition to these species, those ranked under The Nature Conservancy's (TNC) Natural Heritage Network (NHN) ranking system are also discussed.

Federally Listed Species

Of the 17 species on the federal threatened or endangered list for Wyoming, Ute ladies' tresses is the only plant that has the potential to occur in the planning area. Meadow pussytoes, Trelease's racemose milkvetch, Cedar Rim thistle, large-fruited bladderpod, Beaver Rim phlox, and tufted twinpod are Wyoming BLM Sensitive Species. Meadow pussytoes and Payson's bladderpod are USFS Region 4 Sensitive Species, and Swallen Mountain ricegrass and Big Piney milkvetch are Special Status Species of the BLM PFO. These are described in detail below:

- **Ute Ladies' Tresses.** This plant is listed as threatened under the ESA and occurs in Wyoming at elevations below 7,000 feet. It has never been found in Sublette County and likely does not occur in the planning area.

- **Meadow Pussytoes.** Meadow pussytoes is a regional endemic species listed by USFS Region 4 and Wyoming BLM as sensitive. It is ranked in the NHN as global and state imperiled. Meadow pussytoes grows in subirrigated meadows within broad stream channels at elevations of 4,950 to 7,900 feet. It is absent from riparian areas and other locations exhibiting saturated soils and dense graminoid or shrub cover (Fertig and Beauvais 1999). Wyoming locations of meadow pussytoes

include one occurrence in the northern portion of the planning area in the Green River Basin, as well as locations in the Sweetwater River Valley and the South Pass area of the southern Wind River Range in Fremont County. Riparian meadows in the planning area at elevations of 7,200 to 7,900 feet have potential for occurrences of meadow pussytoes (Laster 2002a). Primary threats to the species in Wyoming generally include OHVs, mining, and water projects (Fertig and Beauvais 1999). Grazing is considered a threat but to a lesser extent than originally thought.

- **Trelease's Racemose Milkvetch.** Trelease's racemose milkvetch is a Wyoming BLM Sensitive Species, as well as an NHN state and trinomial imperiled species. It grows on barren hills and washes (Dorn 1992), although little else is known about this species. The Wyoming Rare Plant Technical Committee (WRPTC) is in the process of compiling information for Trelease's racemose milkvetch. Populations are known to occur in Sublette and Uinta counties (Dorn 1992). Two occurrences are known from the southern portion of the planning area. Threats to the species are unknown at present.

- **Cedar Rim Thistle.** Cedar Rim thistle is a Wyoming endemic perennial herb with Wyoming BLM sensitive status and NHN global and state imperiled status. The species grows on barren slopes, fans, and draws in open areas within Wyoming big sagebrush grasslands at elevations of 5,800 to 7,500 feet on specific geologic formations. Known populations of Cedar Rim thistle are limited to the Green River Basin in Sublette County, the Beaver Rim area of Fremont County, the Sweetwater River Valley in Carbon County, and highlands on the east side of Flaming Gorge in Sweetwater County (Fertig and Beauvais 1999). There are three occurrences in the southern portion of the planning area. Pest control measures, including the spraying of herbicides and release of biocontrol insects to control other species of thistle that are invasive, are the main threats to the Cedar Rim thistle. The plant does not appear to be affected by livestock grazing or mineral exploration (Fertig and Beauvais 1999).

- **Large-Fruited Bladderpod.** Large-fruited bladderpod is a Wyoming BLM Sensitive Species and NHN global and state imperiled perennial species. It grows in open Gardner's saltbush–squirreltail communities on barren clay hills and flats (Dorn 1992, Fertig and Beauvais 1999). Generally, populations are found on slopes of less than 15% on low hills, knolls, or colluvial fans at elevations of 6,800 to 7,700 feet. Associated soils are usually fine to textured barren clays and shales (Fertig and Beauvais 1999). The large-fruited bladderpod is endemic to an area less than 25 square miles in size on the western rim of the Great Divide Basin and in the Green River Basin near Opal and Ross Butte, Wyoming (Fertig and Beauvais 1999). Within the planning area, large-fruited bladderpod is known from two occurrences on Ross Butte. Disturbance from oil and gas mining and exploration is a threat to the species. OHV and wild horse activity are also possible threats (Fertig and Beauvais 1999).

- **Payson's Bladderpod.** Payson's bladderpod, a USFS Region 4 Sensitive Species, is a regional endemic of west-central Wyoming, eastern Idaho, and southwestern Montana. It is found on rocky slopes, ridges, flood plains, and along disturbed roadsides at elevations of 5,500 to 10,600 feet. Within the planning area, one known occurrence of Payson's bladderpod exists in the north-central portion of the area (Fertig and Beauvais 1999). The pothole region is an area with a potential for occurrences of this species (Laster 2002a). Generally, threats to Payson's bladderpod are low but may include hiking, OHV use, ski development, grazing, and mining (Fertig and Beauvais 1999).

- **Beaver Rim Phlox.** Beaver Rim phlox was determined in 1988 to be endemic to Wyoming. It is classified as Wyoming BLM sensitive with a high conservation priority. It is also ranked by the NHN as a global and state imperiled species. It grows on dry desert hills on sparsely vegetated slopes with sandstone, siltstone, or limestone substrates at elevations of 6,000 to 7,400 feet (Dorn

1992, WRPTC 1994). Populations of Beaver Rim phlox are known to occur in the Green River Basin in Sublette and Lincoln counties and in southern Fremont County (Fertig and Beauvais 1999). Beaver Rim phlox is known to occur in four locations within the planning area, including one occurrence on Ross Butte. General threats include disturbance from oil and gas development, pipeline construction, and highway construction (Fertig and Beauvais 1999).

- **Tufted Twinpod.** Tufted twinpod is a Wyoming BLM sensitive perennial forb with NHN global and state imperiled status. It is found on dry, rocky, calcareous knolls and ridges, and shaley hills and clay banks. It occurs in openings within sagebrush grassland at elevations of 6,700 to 7,400 feet in sparsely vegetated cushion plant communities (Dorn 1992, Fertig and Beauvais 1999). Tufted twinpod is endemic to the southern Overthrust Belt and lower Green River Basin in Lincoln, Sublette, and Uinta counties in southwest Wyoming (Fertig and Beauvais 1999). Within the planning area, it is known from one location in the southern portion of the area. Tufted twinpod may be adaptable to disturbed sites, and currently, threats appear minimal (Fertig and Beauvais 1999).

- **Swallen Mountain Ricegrass.** Swallen Mountain ricegrass is a perennial bunchgrass with BLM special status in the Rock Springs and Pinedale BLM Field Offices, occurring on sandy to gravely limey-clay soils covered with gravel. The NHN ranks the species as state imperiled and globally secure but possibly rare in parts of its range. It is found on rocky slopes, rims, and mesa summits, often associated with sagebrush grasslands at elevations of 6,500 to 7,900 feet (Dorn 1992, Fertig and Beauvais 1999). Swallen Mountain ricegrass is endemic to east-central Idaho and western Wyoming. Wyoming populations are known only from the western Green River Basin in Lincoln and Sublette counties (Fertig and Beauvais 1999). Populations may be threatened by oil and gas development (Fertig and Beauvais 1999). Populations are known from lands managed by the BLM Kemmerer, Pinedale, and Rock Springs Field Offices, including at least five occurrences throughout the planning area (Fertig and Beauvais 1999).

- **Big Piney Milkvetch.** Big Piney milkvetch is listed as a Special Status Species in the Rock Springs and Pinedale Field Offices. The NHN ranks it as state and globally rare to imperiled. It grows in open areas within sagebrush and cushion plant communities on sandstone, stony clay, badlands, and barren clay slopes and ridges at elevations of 6,900 to 7,200 feet (Dorn 1992, Fertig and Beauvais 1999). Big Piney milkvetch is endemic to the Green River Basin in Sublette County. Reports also place it in Lincoln County, although these are not confirmed (Fertig and Beauvais 1999). More than 30 occurrences are known from a small geographic area within the planning area and the Bridger-Teton National Forest (Fertig and Beauvais 1999). General threats to Big Piney milkvetch include habitat loss and disturbance from vehicles related to natural gas development and exploration activities.

Other Special Status Plant Species

The remaining species, described below, are ranked by TNC's NHN and listed by the Wyoming Natural Diversity Database. These species lack formal federal status or protection, although they are considered locally or regionally rare or imperiled.

- **Sickle Saltbush.** Sickle saltbush is a shrub ranked by the NHN as critically imperiled in the State of Wyoming and globally secure. It grows in sagebrush-dominated communities on desert hills, mesas, draws, and gravel benches with sandy to clayey soil (Dorn 1992, Fertig and Beauvais 1999). The known range of sickle saltbush includes southeastern Washington to northeastern California, and east to Montana, Utah, and Nevada. In addition to southern portions of the planning area in Sublette County, Uinta and Sweetwater counties also contain known populations

(Fertig and Beauvais 1999). Disturbance from mining exploration may affect some populations of sickle saltbush.

- **Divergent Wild Buckwheat.** Divergent wild buckwheat is ranked by the NHN as state critically imperiled and globally secure. It is a low-spreading annual that grows in cushion plant-bunchgrass communities or on the edges of sagebrush grasslands. It prefers barren or semibarren clay, shale, or sandstone hills and washes at elevations of 6,250 to 7,500 feet (Dorn 1992, Fertig and Beauvais 1999). The distribution of divergent wild buckwheat in Wyoming includes the Great Divide and Green River Basins in Sublette, Sweetwater, Lincoln, and Uinta counties (Fertig and Beauvais 1999). Impacts and threats from oil and gas development that could potentially occur in or around populations are unknown (Fertig and Beauvais 1999).

- **California Hesperochiron.** California hesperochiron is a low-growing perennial herb found in moist to dry hills and flats, often in alkaline soils, at elevations of 6,700 to 7,000 feet (Dorn 1992; Fertig and Beauvais 1999). It is ranked by the NHN as critically imperiled in Wyoming and globally secure for most of its range. California hesperochiron is distributed along the West Coast states, western Montana and Wyoming, and northeastern Utah. The Wyoming distribution includes only the Evanston area in Uinta County and the Upper Green River Basin in Sublette County (Fertig and Beauvais 1999). One occurrence is known from the northeast portion of the planning area. Threats to the species have not been identified.

- **Mountain Peppergrass.** Mountain peppergrass is ranked by the NHN as critically imperiled in Wyoming but secure throughout most of its range. It is a perennial herb that is found on meadows, slopes, and disturbed areas, such as roadsides, at elevations of 6,800 to 7,000 feet (Dorn 1992, Fertig and Beauvais 1999). The range of mountain peppergrass is from New Mexico to Utah and Wyoming. Wyoming populations are known from one occurrence in the Green River Basin near the Big Piney and Marbleton areas in the planning area (Fertig and Beauvais 1999). This species may be adapted to disturbance and therefore semiweedy. More research is needed to investigate this possibility. Roadside populations of mountain peppergrass may be susceptible to herbicides or other disturbances (Fertig and Beauvais 1999).

- **Juniper Prickly Pear.** Juniper prickly pear is a clump-forming perennial succulent cactus ranked by the NHN as critically imperiled in Wyoming and rare to secure throughout its range. Habitat includes sandy soils of flats, washes, and hillsides in desert shrub, grasslands, and open grassy flats in southern pinyon-juniper woodlands (Fertig and Beauvais 1999). The Wyoming populations are peripheral and occur in sandy or gravelly substrates with desert shrub at elevations of 6,120 to 6,950 feet in the Green River Basin in Sublette and Sweetwater counties, including one occurrence in the east-central portion of the planning area (Dorn 1992, Fertig and Beauvais 1999). Threats to juniper prickly pear are unknown.

- **Desert Glandular Phacelia.** Desert glandular phacelia is ranked by the NHN as questionably critically imperiled in Wyoming and secure to rare across its range. It grows on semibarren south- or west-facing upper slopes in gray clay shale covered by fragmented slate (Fertig and Beauvais 1999). Less often, desert glandular phacelia may occur on chalky, limey-slate outcrops dominated by cushion plants or in openings within shadscale, green rabbitbrush, and greasewood mixed shrubland (Fertig and Beauvais 1999). Desert glandular phacelia is endemic to the Great Divide Basin and the desert foothills of the Overthrust Belt in southwestern Wyoming in Lincoln, Sweetwater, and Sublette counties (Fertig and Beauvais 1999). One occurrence is known from the Ross Butte vicinity of the planning area. General threats to desert glandular phacelia include OHV activity and mineral exploration.

- **Hoary Willow.** Hoary willow is ranked by the NHN as globally secure but imperiled in Wyoming. This low-growing shrub is found on wet to saturated soils in floating mats, bogs, fens, and willow thickets around ponds from the foothills to montane zones at elevations of 6,600 to 9,200 feet (Dorn 1992, Fertig and Beauvais 1999). Wyoming populations of hoary willow are known from the Absaroka, Beartooth, Laramie, and Medicine Bow ranges; the Yellowstone Plateau; and the Upper Green River Basin, possibly within the planning area (Fertig and Beauvais 1999). Grazing pressures may be a threat (Fertig and Beauvais 1999).
- **Low Spike Moss.** Low spike moss is a perennial moss-like herb that occurs in saturated moss-covered zones in wet meadows at elevations of 7,700 to 8,000 feet (Dorn 1992, Fertig and Beauvais 1999). It is ranked by the NHN as globally secure but critically imperiled in the state. Low spike moss has a large range across North America. In Wyoming, populations are known from the Upper Green River Basin in the planning area and from the foothills of the Wind River and Teton ranges in Sublette and Teton counties (Fertig and Beauvais 1999). General threats to low spike moss populations include development of subdivisions and dam construction (Fertig and Beauvais 1999).

Sensitive Areas

Ross Butte and Ross Ridge are located along Wyoming Highway 351 in the central portion of the planning area. The Ross Butte ecosystem in this area provides habitat for many endemic plant species, including Big Piney milkvetch, Beaver Rim phlox, large-fruited bladderpod, and desert glandular phacelia (Fertig and Beauvais 1999). *The Plant Species of Special Concern of the Ross Butte Ecosystem* report contains the recommendation: "The Ross Butte ecosystem contains one of the highest known concentrations of regionally endemic basin plant species in southwestern Wyoming. Given the growing pressures to develop natural gas and oil resources in southwest Wyoming, the Ross Butte area stands out as a significant potential conservation site" (Laster 2002a).

3.13.3 Noxious Weeds and Invasive Plant Species

Noxious weeds are defined in Executive Order 13112 as those "species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Noxious weed species, when introduced to an area, are aggressive and often dominate natural communities. They are often able to establish in areas following disturbance. As listed in Table 3-50, the State of Wyoming has designated 23 weeds as noxious, 16 of which are known to be a problem within the planning area.

Table 3-50. Noxious Weeds as Designated by the Wyoming Weed and Pest Control Act

Scientific Name	Common Name	Present in the Planning Area
Convolvulus arvensis	Field bindweed	X
Cirsium arvense	Canada thistle	X
Euphorbia esula	Leafy spurge	X
Sonchus arvensis	Perennial sowthistle	X
Agropyron repens	Quackgrass	
Cardaria draba and Cardaria pubescens	Hoary cress	X
Lepiduim latifolium	Perennial pepperweed	X
Chrysanthemum leucanthemum	Ox-eye daisy	X
Franseria discolor	Skeletonleaf bursage	
Centaurea repens	Russian knapweed	X

Scientific Name	Common Name	Present in the Planning Area
Centaurea maculosa	Spotted knapweed	X
Centaurea diffusa	Diffuse knapweed	
Linaria vulgaris	Yellow toadflax	X
Linaria dalmatica	Dalmation toadflax	X
Isatis tinctoria	Dyer's woad	X
Carduus nutans	Musk thistle	X
Hyoscyamus niger	Black henbane	X
Onopordum acanthium	Scotch thistle	
Arctium minus	Common burdock	
Carduus acanthoides	Plumeless thistle	
Cynoglossum officinale	Houndstongue	X
Lythrum salicaria	Purple loosestrife	
Tamarix spp.	Saltcedar	X
Elaeagnus angustifolia	Russian Olive	X

Of the species listed in Table 3-50, perennial pepperweed, leafy spurge, knapweeds, and Dyer's woad are considered to have the highest management priority within the planning area. The Sublette County Weed and Pest Agency is concerned with known significant infestations of perennial pepperweed along Muddy Creek north of Big Piney and along the Green River south of Big Piney to LaBarge (Laster 2002b). Sublette County has created a list of weeds it manages to control in addition to the previously listed species. This list includes black henbane and scentless chamomile.

Other weed species present within the planning area, although not officially designated noxious, can be disruptive to native plant communities. These include cheatgrass, halogeton, and Russian thistle. Of these, halogeton is the most problematic in the planning area. Weeds are present primarily in areas of disturbance, including along roads, in areas of oil and gas development, and in heavily grazed areas. Geographic information system (GIS) data for weed populations have not been completed for most of the planning area.

3.14 VISUAL RESOURCES

Visual resources in the planning area are influenced by the different characteristics of the two physiographic provinces in the region: Wyoming Basin and Central Rocky Mountains province.

The Wyoming Basin is located in the west-central portion of the state, bounded on the north by the Wind River Range and on the south by the Uinta Range. The province extends east to the Red Desert and west to the foothills of the Wyoming Range. Typically, the landform is composed of low mountains, low rolling or flat-topped hills, and isolated hills. The soils are highly erodible and, together with the multicolored sedimentary bedrock of the region, form the colorful badlands landscape common throughout most of the province. Most of this area is shrub steppe, dominated by sagebrush, greasewood, and saltbush. The higher elevations are dominated by mountain shrub vegetation, with coniferous forest atop the highest areas.

The Central Rocky Mountains physiographic province extends from the western edge of Wyoming south into Colorado, north to the Montana/Wyoming border, and west into Idaho. The province is characterized by high, rugged, glaciated mountains rising to elevations of up to 13,000 feet. Glaciation has left broad flat valleys between mountain ranges. Deep, V-shaped drainages with steep, rocky slopes are common. Elevation determines the dominant vegetation. The areas of highest elevation support alpine tundra, the subalpine zone is dominated by Engelmann spruce and subalpine fir, and a mix of lodgepole pine and Douglas fir occurs in the lower montane zone. Fire can change forests in either of those zones to a pure lodgepole pine stand or aspen forest. Grass and sagebrush occur under open pine forests that grade downslope into grasslands, woodlands, or shrub steppe.

3.14.1 Scenic Views

Within the planning area, the diversity of topography and landforms exhibited by these two distinctly different topographic zones creates an extraordinary variety of visual contrasts and scenic beauty. The planning area contains a major river system and watershed, the Upper Green River, and borders the slopes of several major mountain ranges: Gros Ventre Range to the north, Wind River Range to the east, and Wyoming Range to the west. The New Fork River is a major tributary of the Green River and flows south along the foothills of the Wind River Range.

Numerous areas within the planning area exhibiting high degrees of scenic quality are easily accessible to tourists and other recreationists. Some examples of high-quality scenic views and viewsheds within the area are as follows:

- The Green River and valley is highly scenic. River floaters can enjoy a variety of scenic landforms, vegetation, and wildlife.
- In the vicinity of the town of Pinedale, adjacent to the Wind River Front, is an area that includes very scenic foothill country adjoining the Bridger National Forest. It includes the lands adjacent to Fremont, Soda, Willow, and New Fork lakes.
- Scab Creek, an area of extraordinary scenic views, contains some of the best scenery of BLM-administered lands in Wyoming. This area is typified by steep, rugged rock outcrops, aspen, lodgepole pine, and Douglas fir stands interspersed with grassy meadows, small lakes, and streams.
- The Mesa, an extensive, flat-topped highland south of Pinedale, provides excellent views of all the mountain ranges in the area.

- The stretch of road along Highway 352 in the vicinity of the town of Cora encompasses the majority of the land between the town of Pinedale and the Warren Bridge Campground. The upper New Fork flows adjacent to this highway and provides excellent views of the Wind River and Gros Ventre Ranges to the northeast.
- A section of the LaBarge Creek Road passes between Lake Mountain and Miller Mountain, providing one of the most scenic drives through the Wyoming Range. The area consists of steep canyons, scenic rock outcrops along narrow canyon bottoms, and clear streams lined with aspens and willows. The landscape view leading to the mountain foothills is high, rolling plains interspersed with colorful mesas and buttes.
- Blue Rim and Ross Butte provide a high desert landscape that is bounded on the north and west by the New Fork and Green rivers. Dramatic views of a colorful and massive badland escarpment are most evident to river floaters and to travelers along Highway 351 and Highway 189.

3.14.2 Visibility

Refer to Section 3.2, Air Quality for discussion of visibility.

3.14.3 Visual Resource Management System

The planning area has been inventoried in accordance with the procedures described within BLM *Visual Resource Inventory Handbook H-8410-1* and divided into four Visual Resource Inventory classifications, based on scenic quality, visual sensitivity levels, and viewer distance zones. Visual Resource Inventory classifications I through IV establish visual values with I having greater value than IV. The Visual Resource Inventory is considered, along with BLM's allocated resources, in the assignment of Visual Resource Management (VRM) Classes I through IV, which prescribe VRM objectives. VRM Class boundaries vary in each alternative to reflect potential management actions in consideration of the visual values defined in the inventory and other resource decisions. Each VRM classification has a management objective, as described below:

- **Class I.** The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activities. The level of change to the characteristic landscape should be very low and should not attract attention.
- **Class II.** The objective of this class is to retain the existing character of the landscape. The level of change to the landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes to the landscape must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- **Class III.** The objective of this class is to partially retain the existing character of the landscape. The level of change to the landscape should be moderate. Management activities may attract the attention of the casual observer but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- **Class IV.** The objective of this class is to provide for management activities that require major modifications to the existing character of the landscape. The level of change to the landscape can be high. The management activities may dominate the view and may be the major focus of viewer attention. However, every attempt should be made to minimize the effect of these activities through careful location, disturbance minimization, and repetition of the basic visual elements of form, line, color, and texture (USDI, BLM 1986b).

The established VRM classes for the planning area are depicted on Map 2-14. Table 3-51 provides the acreages for each VRM class for the planning area, as established in the 1988 RMP and carried forth into Alternative 1 as the Continuing of Existing Management Alternative.

Table 3-51. Visual Resource Management Classifications and Acreage

Classification	Acres
I	21,290
II	73,430
III	187,070
IV	641,140

Source: BLM 2006.

Note: All lands in the planning area were rated; however, only the BLM-administered lands are managed within the VRM system, and only BLM lands are included in the acreages referenced above.

The VRM classification for the South LaBarge and Fontenelle Creek area is not consistent with the VRM classification of lands south of Fontenelle Creek in the Kemmerer BLM Field Office area. The north side of Fontenelle Creek, from Mammoth Hollow to the Highway 189 corridor, is classified as VRM Class IV. On the south side of Fontenelle Creek (Kemmerer side), the landscape has been classified as VRM Class II (Hudson 2002, Mierzejeweski 2002).

VRM classifications generally are not consistent across boundaries between the Pinedale and Rock Springs BLM Field Offices. The Highway 191 travel corridor designated as Class III in the planning area becomes Class IV in the Rock Springs Field Office area; a Pinedale Class III area in the vicinity of Muddy Creek (west of Irish Canyon) is Class II in the Rock Springs Field Office area.

3.14.4 Visual Resource Trends

OHV Use

The existing Pinedale RMP describes those areas that have been designated for OHV use. OHV use has increased in the planning area. OHV use for recreational and nonrecreational purposes is creating noticeable visual impacts in some areas. Visual impacts produced by OHVs include trails and roads that are most visible on steep or erosive soils. Known areas of impacts on scenic quality from OHV use include the Red Canyon area in the foothills of the Wyoming Range; localized small areas of the Blue Rim; and areas near the towns of Big Piney, Marbleton, and Pinedale. Section 3.12.3 provides additional information on OHV use and resource conflicts.

Fluid Mineral Development and Other Surface Disturbing Activities

The trend toward continued expansion of oil and gas development within the planning area may be creating cumulative visual impacts that potentially conflict with the established VRM class objectives. The following areas are identified as areas of potential conflict: (1) Mesa area (south and west of Pinedale); (2) Upper Green River Valley west and east of US Highway 191; (3) historic Oregon Trail; (4) US Highway 191 and 189 travel corridors; and (5) areas along the Wyoming and Wind River Fronts.

Other surface disturbing activities in the planning area include housing development expansion along the foothills of the Wind River Range and associated activities, including an increased number of gravel pits, roads, and utility ROWs.

Visual Sensitivity

A trend is developing in which the public is becoming more sensitive to the scenic values of the area. As the number of residents, travelers, and recreationists increases, this heightened sensitivity is likely to increase.

3.15 WATERSHED AND WATER QUALITY (SURFACE WATER AND GROUNDWATER)

This section focuses primarily on surface watersheds because these are the components of the hydrologic cycle most vulnerable to management choices. The quantity of water available in the planning area, current uses of water, water quality, and the regulatory framework surrounding water use are discussed.

Water resources include surface and subsurface sources. Hydrological conditions affect riparian, wildlife, and fishery resources, and cause economic consequences to manmade structures and the water supply.

3.15.1 Surface Water

Watersheds

The planning area lies almost entirely within the Green River drainage. It contains portions of four separate watersheds located within the Upper Colorado hydrologic region (Region 14) and is adjacent to the Pacific Northwest hydrologic region (Region 17). These boundaries are shown on Map 3-13. Within the Upper Colorado region, the bulk of the planning area lies within the Upper Green River and New Fork River watersheds, part of the Green River drainage. Very small portions of the planning area lie within the Big Sandy and Slate watersheds, also part of the Green River drainage. These watersheds are defined by a hydrologic unit code (HUC) that identifies the specific hydrologic unit and consists of a two-digit sequence for each specific level within the delineation hierarchy. The original HUCs assigned by the USGS in the 1970s were composed of eight digits and defined fourth-order watersheds. Since then, diverse efforts to further subdivide these original areas culminated in 2001 in a draft standard for delineating a nationally consistent hydrologic unit coverage. Subwatersheds are the sixth level (12-digit) in this hierarchy and generally range from 10,000 to 40,000 acres in size. All of the watersheds in Wyoming have been designated at the subwatershed level. The hydrologic unit selected for consideration depends on the scale of the project being considered.

Surface water in the planning area is greatly influenced by topography and geology. The planning area is characterized by a high plateau, dissected by the Green River and its tributaries, bounded to the north and east by the Wind River Range and to the west by the Wyoming Range and Absaroka Ridge. Glacial deposition features have created numerous lakes on the slopes of the Wind River Range; however, most of these lakes lie just outside the planning area boundary (Woolley 1930).

The Green River, the major drainage in the planning area, arises on the western slope of the north end of the Wind River Range before turning south and entering the planning area. The Green River runs through an alluvial valley the entire length of the planning area to the southern boundary at Fontenelle Reservoir. The major tributary to the Green River is the New Fork River, whose tributaries arise from the glacial lakes on the western face of the Wind River Range. The New Fork River follows its own alluvial valley through a rolling plateau area, crossing south of the Mesa and joining the Green River in the vicinity of Big Piney. The land downstream of the New Fork River and east of the Green River consists of an arid, slightly rolling plateau known as the Little Colorado Desert (Woolley 1930). The Green River, from the northern boundary of the planning area to the confluence with the New Fork River, is designated as Class 1 waters by the State of Wyoming. Class 1 waters are defined as “outstanding waters” (DEQ 2001b) and are those surface waters in which no further water quality degradation by point source discharges, other than from dams, will be allowed. Nonpoint sources of pollution in Class 1 waters are controlled by the implementation of appropriate best management practices.

Tributaries that drain the area west of the Green River include North Piney Creek, Middle Piney Creek, South Piney Creek, Cottonwood Creek, LaBarge Creek, and Fontenelle Creek, all of which arise from the east face of the Wyoming Range and flow through bluffs and buttes formed from a highly dissected

plateau.

Surface Water Supply and Use

Surface water is stored in several large and small reservoirs. Fontenelle Reservoir is the largest (345,000 acre-feet of storage). Other reservoirs include McNinch Number 1 Reservoir (1,100 acre-feet), McNinch Number 2 Reservoir (200 acre-feet), and Sixty-seven Reservoir (5,000 acre-feet).

Water in the planning area is used for agricultural, municipal, industrial (primarily oil and gas production), and recreation purposes. Table 3-52 shows the current water use in the planning area.

Table 3-52. Water Use in the Planning Area

Water Use	Annual Surface Water Use (acre-feet)	Annual Ground-water Use (acre-feet)	Total Annual Water Use (acre-feet)	Percentage
Municipal	924	610	1,534	0.7
Domestic (rural)	Unknown	Unknown	1,936[a]	0.9
Irrigation	213,292	Minimal	213,292	98
Industrial	Minimal	788	788[a]	0.4
Total			**217,550**	**100**

[a] Water use was assumed to be half of that given for the basin as a whole.
Source: States West Water Resources Company 2001.

Municipal and domestic water use account for less than 2% of the total water use in the planning area. Only four municipal supply systems are located in the planning area. Pinedale and LaBarge rely on surface water, whereas Marbleton and Big Piney rely on groundwater wells for their water supply. Domestic supply wells located in rural areas beyond the reach of the municipal supply systems most likely use the same amount of water (or more) as the major towns.

Irrigation (primarily for hay fields) is the greatest water use in the basin, with roughly 186,000 irrigated acres accounting for 98% of all water use, mostly from surface water diversions (States West 2001). Major industrial users of surface water in the Green River Basin include soda ash production, power generation, and chemical manufacturing; however, no major surface water industrial users are located in the planning area (States West 2001). "Oil and gas companies often secure water rights to use the water for onsite purposes, such as producing drilling mud and dust abatement. The actual water use at the wells during the drilling process is typically short term and, often, the terms of the water rights are limited" (States West 2001). Although oil and gas industries use some surface water for domestic supplies or fire protection, "their major water supplies come from groundwater wells or groundwater sources that are by-products of their operations. The permitted capacity of the industrial wells is typically much larger than the actual use, which is relatively small and temporary in nature. The fact that there is water right for an industrial well cannot be considered a reliable indication of water use. The actual well may no longer be in use, or if it is being used, the duration of the actual pumpage is probably limited" (States West 2001).

Surface Water Quality

The State of Wyoming has primacy with regard to water quality. Adhering to WDEQ standards is required by law. Surface water quality problems are detailed in Wyoming's 303(d) List of Waters Requiring Total Maximum Daily Loads (TMDL), required under the Clean Water Act. The 2006 303(d) list is incorporated into three lists: (1) 2006 303(d) Waters with Water Quality Impairments, (2) TMDL 2006 303(d) Waters with National Pollutant Discharge Elimination System Discharge Permits containing Wasteload Allocations, and (3) 2006 303(d) Waters with Water Quality Threats. No waterbodies in the planning area are on the first and third lists (WDEQ 2006). Two waterbodies within the planning area

(North Piney Creek below Big Piney wastewater treatment facility and Reardon Draw [lower 3 miles from confluence with Green River]) were delisted from Wyoming's 2004 303(d) list (WDEQ 2006). Portions of the Green River below the LaBarge Wastewater Treatment Facility, as well as Pine Creek below the Pinedale Wastewater Treatment Facility, are included in the second 303(d) list, with permits expiring on November 30, 2006, and September 30, 2006, respectively (WDEQ 2006). The TMDLs for these segments are for ammonia, chlorine, and fecal coliform (WDEQ 2006).

Overall, surface water quality generally is good in the planning area. Total dissolved solids (TDS) for the waters of the Green River drainage above Fontenelle Reservoir, including the New Fork River drainage, are on average less than 500 milligrams per liter (mg/L), have an acceptable pH range of 6.5 to 9.0, and have temperatures ranging from 0°C in the winter to 25°C in the summer (States West 2001, Hargett 2003, Garton 1998, Rieger 2004, Hargett 2005). Phosphorus levels at four of the monitored streams in the planning area are below 0.1 mg/L; these levels do not suggest a nutrient problem (Hargett 2003, Garton 1998, Rieger 2004, Hargett 2005). However, total phosphorus concentrations can reach levels that could cause nuisance algae and aquatic plant blooms in later summer or early fall (States West 2001, Hargett 2005). Point source pollution is managed by the WDEQ.

The State of Wyoming classifies surface waters according to the quality and value to people of the state. For information on these classifications, refer to the website for the WDEQ surface water standards (http://deq.state.wy.us/wqd/watershed/surfacestandards/index.asp).

Currently, an interbasin diversion of water exists from LaBarge Creek to Muddy Creek. The water is used for irrigation, but the disruption to the natural drainage tends to cause high sediment yield. This diversion is a major source of sediment for Muddy Creek, although it is probably not a large source of sediment for the drainage as a whole.

As part of the Upper Colorado River system, the planning area is subject to the Colorado River Salinity Control Act. No specific projects in the planning area are designed to reduce salinity at a given point. However, downstream salinity and sedimentation is minimized by actions such as vegetation management and access route planning.

Surface Water Rights

Surface water is allocated through water rights as established by the Wyoming constitution under the doctrine of prior appropriation, or "first in time, first in right." However, water rights are considered property rights that are appurtenant to the land and can be transferred in use or location only after review by the State Engineer's Office or the Board of Control.

No BLM water rights reserved to the Federal Government exist within the planning area. All BLM water rights are established through the Wyoming State Engineers' Office (Doncaster 2002a). Under Wyoming law, water rights may be established for instream flows. These rights are filed and granted on unappropriated water, either natural flow or as releases from reservoirs, to maintain and improve fisheries. Nine instream flow rights have been filed for by the State of Wyoming within or immediately adjacent to the planning area. In addition to instream flow rights, the WGFD has established recommended minimum maintenance flows on many streams in the area to support game fish populations in the late-season, low-flow months.

Flood Plains

Approximately 24,920 acres of public land within the planning area are within the 100-year flood plains (Map 3-14). The status of the functioning condition of riparian vegetation along the public land segments of major waterways was documented using the PFC method. The condition of the flood plain and stability of stream banks still need to be documented.

Overall Watershed Stream Health

Based on surveys conducted between 1993 and 2002 using the PFC method, the condition of streams within the planning area watersheds is generally good throughout the higher elevations. These reaches have more streamside vegetation and coarser, more stable substrate. The high-elevation streams are mostly perennial with high-frequency and low-magnitude flow events.

The condition of intermittent and ephemeral streams at lower elevations within planning area watersheds is generally poorer. This is generally a result of streambank vegetation conditions, the flashiness of the runoff (i.e., lower-frequency, high-magnitude floods), and the presence of finer-grained substrate more vulnerable to erosion. Information on functioning condition of streams by allotment is provided in Table 3-, p. 3-34.

3.15.2 Groundwater

Groundwater Supply and Use

Eight major aquifer systems are identified in the planning area. Most of the bedrock surface exposures in the area are Cretaceous and Tertiary age rocks, which include several aquifer systems, including the Frontier aquifer (western part of the basin), Mesa Verde aquifer system, and Tertiary aquifer system (States West 2001). The Tertiary aquifer system is composed of numerous water-bearing formations, including the Wasatch and Fort Union Formations (States West 2001). Most of the groundwater used in the planning area derives from the Tertiary aquifer system or the Quaternary sands and gravels associated with the major river courses (States West 2001). In the central portion of the planning area, water wells are generally less than 300 feet deep, with groundwater levels ranging from 10 feet below the surface in drainages to 100 feet on interstream divides (BLM 1999b). In the southeastern portion of the planning area, south of the New Fork River, estimated steady-state groundwater levels (i.e., with no pumping) show that groundwater levels slope gently from the northeast to the southwest (BLM 2006).

The main uses of groundwater in the planning area are for municipal and industrial purposes. Industrial use of groundwater is primarily for oil and gas drilling in the planning area (Table 3-52, p. 3-121). Based on historic TDS concentrations and WDEQ groundwater suitability standards, groundwater within the planning area tends to be suitable for livestock water (<5,000 ppm) and is often within the range for agricultural water (<2,000 ppm). Water of less than 500 ppm TDS is considered potentially suitable for domestic water.

Groundwater Quality

Groundwater quality varies throughout the planning area based on location, depth of well, and geologic unit. Groundwater at the northern, western, and eastern periphery of the planning area is nearer to high recharge areas in the surrounding mountain ranges and generally has a TDS concentration less than 500 mg/L, which is considered suitable for domestic use. However, groundwater elsewhere in the planning area can exceed TDS concentrations of 3,000 mg/L, which is still suitable for livestock use. Levels of TDS exceed the standards for drinking water in more than half of the sampled groundwater wells (States West 2001). The water quality at other wells is considered poor and would require treatment to be suitable for domestic use (States West 2001). In the central portion of the planning area, groundwater discharging into streams is considered to be of good quality, comparable with that in supply wells (BLM 1999b). Groundwater produced in natural gas wells in the southeastern portion of the planning area, in the Jonah field area, varied in quality, but TDS averaged between 2,000 and 5,000 mg/L (BLM 2006). In these aquifers, untreated produced water is not suitable for domestic use and is only marginally suitable for agriculture, but is suitable for livestock use.

Groundwater quality in shallow alluvial aquifers generally is reduced by calcium bicarbonate (BLM

1999b). In the Wasatch Formation, ions are sodium bicarbonate in shallow zones and sodium sulfate in deeper sandstones (BLM 1999b). In the southeastern portion of the planning area (Jonah field area) chloride concentrations in produced waters exceeded state groundwater standards for domestic, agricultural, and livestock use in three of the wells tested (BLM 2006). Iron concentrations also exceeded the standards for domestic and agricultural use in many of the sampled wells. Other groundwater quality problems throughout the planning area are caused by iron, manganese, fluoride, and nitrate (Lowham et al. 1985).

Disposal of water is an issue that has recently developed in the planning area. Large amounts of water can be generated from conventional or CBNG wells, as is discussed more thoroughly in Section 3.7. This water can be saline and/or sodic. Salts that are mobilized in the Green River portion of the planning area, which constitutes the majority of the land surface, eventually flow into the Colorado River. Salinity levels in the Colorado River are a regional, national, and international issue. Injection of produced waters into geologic formations is a potential avenue of disposal. Disposal of water needs to be in compliance with WDEQ regulations.

3.16 WILD HORSES

Wild horses were removed from the Pinedale planning area in the early 1990s (Powell 2002), as specified in the 1988 RMP. The two herd management areas, Desert Herd and LaBarge Herd, still exist but are not managed for wild horses at present. The removal of the wild horse herds has resulted in decreased conflicts for forage and water. A small wild horse group eluded capture in the 1990s and remains in the Desert Herd management area, mainly in the South Desert Allotment. Currently, the herd number is low (around 12), and conflicts with the resource use in that area are minimal. The consent decree with the State of Wyoming requires all wild horses be removed from this area.

3.17 WILDLAND FIRE AND FUELS

Wildland fires occur as a result of an act of nature, such as lightning; human accident, often associated with use of fireworks, woodcutting, and camping; arson; or prescribed burning. Prescribed fires are implemented for beneficial purposes, such as for wildlife habitat enhancement, forage production, and fuel reduction. Review of the available historic fire data for the planning area indicates that wildland fire frequency has been low. Of the 30 historic wildland fires in the planning area, lightning accounts for half of the fires and human activity for the other half. Only five of those fires burned more than 100 acres. Prescribed fire has been used 10 times since 1988 within the planning area and burned approximately 8,700 acres.

3.17.1 Fuel Reduction

Prescribed fire, wildland fire use for resource benefit, mechanical and chemical treatments, and biological agents are methods that can be used to treat vegetation and reduce fuel loadings. Wildland fire use for resource benefit is the management of wildland fire to accomplish prestated resource management objectives in predefined geographic areas outlined in the fire management plan. Mechanical treatments include, but are not limited to, chainsawing, shearing, chipping, mowing, and brush beating. Chemical treatment of vegetation to meet resource or fuel reduction objectives includes, but is not limited to, the use of Tebuthiuron to thin sagebrush. Currently, the BLM is developing a programmatic EIS for the use of herbicides in the 12 western states.

3.17.2 Fire Suppression

The appropriate management response is a set of specific actions taken in response to a wildland fire that can range from immediate full initial attack suppression to monitoring a fire's progress. The appropriate management response for every area in the planning area will be documented in the fire management plan. Specific criteria are used to determine when wildland fire use is meeting resource objectives or when it becomes a wildland fire suppression situation.

3.17.3 Wildland-Urban and Wildland-Industrial Interface Locations

Five urban interface areas and two industrial interface areas have been identified. They include Hoback Ranches, Upper Green, Pocket Creek, Pinedale, Boulder, and the existing industrial interface and natural gas developments in the Jonah and Anticline Fields. The focus in these areas is on fuel reduction, fire prevention, and fire suppression.

3.17.4 Fire Ecology

The condition class of vegetation communities has been the focus of fire management planning as a result of implementing the following plan: *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment—10-Year Comprehensive Strategy Implementation Plan* (May 2002). The condition class refers to the level of departure from the natural historic fire frequency and severity in an area, the associated change in vegetation, and the composition and structure of fuels. It also refers to the ecological risk of losing key ecosystem components because of this departure. Condition Class 1 has low, minimal, or no departure from the historic range of variability; Class 2 has a moderate departure; and Class 3 has a high departure.

The vegetation in the planning area can be categorized into fire regime groups II, III, IV, and V. Fire regime group II includes shrub communities that experience a fire return interval of 0–35 years at a stand replacement severity. Fire regime group III consists of the shrubland and mixed conifer communities that have a fire return interval of 35–100+ years and experience mixed severity fires. Fire regime group IV

occurs in the lodgepole stands in which the fire return interval is also 35–100+ years but which has a stand replacement severity. Fire regime group V occurs in spruce-fir stands that experience a fire return interval of greater than 200 years at a stand replacement severity. Descriptions and locations of major vegetation types can be found in Section 3.13.

3.17.5 Emergency Stabilization and Rehabilitation

Emergency stabilization and rehabilitation refers to activities that may be implemented following wildland fire. Common activities may include seeding with native or non-native species, controlling noxious weeds, controlling erosion, repairing fences that were burned, and building new temporary management fences. Following wildland fire, BLM resource specialists evaluate impacts to decide whether emergency stabilization or rehabilitation activities are warranted, based on vegetation condition, soils, fire size and intensity, stream conditions, slope, improvements burned by fire, and so forth. Currently, emergency stabilization and rehabilitation activities are completed after a written plan has been approved by both the BLM Wyoming State Office and the BLM Washington Office.

3.18 WILDLIFE AND FISH HABITAT

The diverse natural communities throughout the planning area support a wide variety of wildlife and fish species, including several Special Status Species. This section presents the current known status, distribution, and natural history of wildlife within and specific to the planning area. The scientific names of the species discussed are provided in Appendix 23. Although many of these species occupy the planning area all year, some species are present only seasonally.

3.18.1 Terrestrial Wildlife

Game Species

Big Game

BLM-administered public lands, state lands, and private lands provide habitat for pronghorn (Map 3-15), mule deer (Map 3-17), white-tailed deer, elk (Map 3-18), moose (Map 3-19), black bear, and mountain lion. Furthermore, BLM-administered lands provide the majority of the crucial winter habitat for mule deer and elk populations found in the Upper Green River Basin. Crucial habitat consists of any particular range or habitat component that is the determining factor in a population's ability to maintain and reproduce itself at a certain level over the long term (as defined by the WGFD). Table 3-53 shows the acreage of public land managed as big game crucial winter range and parturition areas (Maps 3-20 and 3-21). Table 3-54 shows the status of big game populations.

Table 3-53. Big Game Crucial Winter Range and Parturition Areas

Type of Crucial Winter Range	Acres (public land only)
Big game crucial winter range	
Pronghorn	125,400[1]
Elk	107,050[1]
Mule deer	319,300[1]
Moose	81,445
Total	**495,340[1]**
Big game crucial winter range overlap with oil and gas fields	
Pronghorn	20,640[1]
Elk	14,260[1]
Mule deer	92,260[1]
Moose	4,660
Total	**110,300[1]**
Parturition area	
Pronghorn	21,790
Elk	58,570
Mule deer	16,710
Total	**97,250**

[1] Crucial winter ranges may overlap crucial winter range for other big game species.

Table 3-54. Big Game Population Status

Species	Herd Unit	Hunt Areas	Population Estimate[1] 2006 Post-Season	Population Trend	Average Buck: Doe	Population Objective[2]
Pronghorn	Sublette	85–93, 96, 107	60,100	Stable	0.53:2	48,000
Mule deer	Sublette	130, 138–142, 146, 150–156, 162	26,474	Stable	0.29:1	32,000
	Wyoming Range	134, 135–137, 143–145, 147	26,967	Stable	0.32:2	50,000
Elk	Upper Green River	93, 95, 96	2,567	Stable	0.25:1	2,500
	Pinedale	97, 98	1,953	Decreasing	0.28:1	1,900
	Piney	92, 94	3,227	Increasing	0.30:1	2,400
	Hoback	86, 87	1,062	Decreasing	0.16:1	1,100
Moose	Sublette	3–5, 10, 20–25	4,066	Increasing	0.50:4	5,500

[1] Data from Wyoming Game and Fish Department Annual Big Game Herd Unit Report, 2006.
[2] Postseason populations.

Pronghorn

Pronghorn seasonal use areas are shown on Map 3-15. The Sublette pronghorn herd unit encompasses 10,546 square miles. The majority of the planning area falls within this large area. The herd unit is managed for a postseason population objective of 48,000 pronghorn. An estimated population of 49,500 was present in 1999, with a 5-year average (1994–1999) of 43,260 (WGFD 1999). Pronghorn are predominantly associated with low, rolling terrain supporting open grassland and sagebrush communities. Summer and winter habitat is present throughout the planning area.

Preferred pronghorn habitat is usually characterized by the presence of summer water and sagebrush in combination with rabbitbrush and antelope bitterbrush. Pronghorn generally do not inhabit areas in which sagebrush exceeds 2 to 3 feet in height (Sawyer and Lindzey 2000).

Pronghorn herds are known to migrate up to 150 miles between summer ranges in the Jackson Hole Valley and wintering areas along the Green River near Seedskadee National Wildlife Refuge south of the planning area (WYDOT 2002). Most of the migration between Grand Teton National Park and the Upper Green River occurs on USFS-administered lands, whereas the remainder of the migration, from the Upper Green River south into Green River Basin, occurs on BLM and private lands (Map 3-16). During spring migration, pronghorn travel across the top and western edge of the Mesa and through the Trapper's Point Bottleneck. Archeological records suggest that this area has been a migratory bottleneck for thousands of years, perhaps because pronghorn prefer to remain in sagebrush habitats while migrating.

The availability of browse, especially sagebrush, appears to be the limiting factor for pronghorn on the winter range. Under severe winter conditions, pronghorn are further confined to limited crucial range generally occurring on lower south-southwest facing slopes that remain open during adverse conditions. Salt desert shrubs also are an important forage species in some areas (USDI, BLM 1986a).

Pronghorn require readily accessible water, which may be a limiting factor on the summer range (USDA 2002). The water requirements are met through foraging on plants and consumption of snow and natural surface water. However, adequate water is also available in reservoirs, pits, troughs, and wells during

May and June. During dry years, water availability may be limited in late summer and fall when reservoirs may be dry and some wells are deactivated.

Because pronghorn tend to crawl under fences rather than jump over them, BLM fence specifications require placing the bottom wire high enough to allow pronghorn to pass without affecting the containment of livestock. The Jackson Hole Pronghorn Study (Sawyer and Lindzey 2000) counted 35 fences that the pronghorn would have to cross during their migration. Although any new public land fences are constructed within specifications of the *BLM Fence Handbook 1741-1*, older fences are not, and new fences constructed on state or private lands are not restricted to these specifications. Occasionally, snow may build up in the area between the bottom wire and the ground where it may impede herd movement. When problems with herd mobility are identified, the fences are modified or gates on these fences are opened, especially during severe snow years.

Mule Deer

Mule deer seasonal use areas within the planning area are shown on Map 3-17. Mule deer from the Sublette and Wyoming Range herd units are found in the planning area. Deer are primarily browsers, and big sagebrush is the key browse species year round (USDI, BLM 1986a). The winter diet of mule deer may be supplemented by true mountain mahogany, rabbitbrush, bitterbrush, and serviceberry; however, these shrubs are limited in quantity.

The Sublette mule deer herd is highly migratory, often spending 5 to 6 months per year on transition ranges. These areas are usually sagebrush habitats in lower elevations with south-southwest facing slopes or on mesa tops where the snow is blown clear. Winter and crucial winter ranges are very important components of the Sublette mule deer herd's range. Summer and transition ranges also play an important role in the survival of the species. The relative importance of each will likely change annually, but the loss or degradation of one will not be compensated for by the others, and the mule deer population will suffer in the long run. The two most important mule deer migration bottlenecks are at Trapper's Point and the south end of Fremont Lake.

Public lands in the planning area provide more than 100,000 acres of summer habitat for mule deer (USDI, BLM 1986a). According to the Sublette Mule Deer Study (Sawyer and Lindzey 2001), most deer seasonally migrate 40–100 miles north/northwest during the summer to portions of five different mountain ranges: the Gros Ventre Range, Wind River Range, Snake River Range, Wyoming Range, and Salt Range (Map 3-16). Important features of mule deer migration routes include highway crossings, river crossings, and migration bottlenecks. Common transition areas include Beaver Ridge, Boulder, Fremont, Willow and New Fork Lakes area, and the Hoback Basin.

Sawyer et al. (2006) report a 46% reduction in wintering mule deer on the mesa portion of the Pinedale Anticline associated with a 2% direct habitat disturbance during 5 years of development.

Elk

Elk seasonal distributions within the planning area are shown on Map 3-18. During the winter, elk are widely distributed on lands at lower elevations, in areas with windswept ridges, or at elk feedgrounds. Crucial winter habitat is found along the west and northeast borders along windblown ridges and south-southwest facing slopes. Most elk migrate to the Bridger-Teton National Forest in the summer (Map 3-16). However, some elk remain on the higher-elevation BLM-administered lands throughout the summer in areas where cover is adequate and disturbing activities are minimal (USDI, BLM 1985). Dense aspen stands with dead falls are vital and serve as parturition areas (Map 3-21). Elk diets consist mostly of grasses and forbs, with grasses being the dominant forage in spring and forbs being the dominant forage in summer months (Clark and Stromberg 1987). Aspen is also recognized as a preferred forage plant for elk in the summer (USDA 1996). Shrubs are consumed year-round but are especially important on the winter range when forbs and grasses are less accessible as a result of snow cover. BLM-administered lands provide less cover for elk and have a higher degree of road access than the adjacent USFS-

administered lands. Nonetheless, they are important because the long stringers (continuous strands) of cover along ridges allow elk access to forage and winter range (USDI, BLM 1986a). High country areas along the forest boundary (aspen-conifer associations) support considerable spring/fall and some summer elk use, including parturition.

Winter feedgrounds were incorporated into the planning area during the late 1940s and early 1950s to contain and provide supplemental food for elk that were damaging private haystacks during the winter. These feedgrounds reduced elk depredation of rancher's haystacks. The WGFD, through an MOU with the BLM, administers 10 winter feedgrounds (Map 3-18). The establishment of the feedgrounds halted the migration of elk to traditional winter ranges in the Little Colorado desert and other lower-elevation areas. However, even with the existence of the feedgrounds, elk occasionally use private lands during the winter months.

Moose

Moose seasonal use areas within the planning area are shown on Map 3-19. The planning area supports the Sublette herd unit. Moose can be found along willow-covered riparian communities and on the aspen-conifer foothills throughout the year (USDI, BLM 1985).

Moose are generalist browsers and are known to eat willow, bitterbrush, Douglas fir, serviceberry, subalpine fir, mountain ash, white-barked pine, cottonwoods, sedges, rushes, and blue spruce (USDI, BLM 1985, Clark and Stromberg 1987). Some intermediate areas between the stream bottoms and higher summer range are used during spring and fall. Winter populations are considerably larger than summer populations, because moose summering at higher elevations on the Bridger-Teton National Forest migrate to the lower stream bottoms to escape extreme snow depths (USDI, BLM 1985). Crucial winter and yearlong habitat is found along most major drainages throughout the planning area.

Black Bear

Black bear are found within the aspen-conifer areas along the Wind River Range during spring and early summer (USDI, BLM 1985). These bears appear to move to higher, more remote areas during midsummer and fall. Along the Wyoming Range, black bear are found in the timbered areas along the Bridger-Teton National Forest boundary and on the Hoback Rim. Some bears appear to remain in this area year-round, whereas others use the area for hibernation and early spring range, moving into the higher Bridger-Teton National Forest during summer and fall. Black bear are omnivores and opportunistic feeders who consume foods essential to replenishing body fat for the winter hibernation and for reproductive success.

Mountain Lion

Mountain lions are fairly uncommon, but sightings are reported occasionally. This species has one of the widest distributions of any native mammal in the western hemisphere and therefore occupies a wide variety of plant communities. Typical mountain lion habitat in western North America is open woodland and shrubland, especially oak scrub, pinyon, juniper, ponderosa pine, spruce, fir, and aspen, as well as shrublands such as sagebrush, desert shrub, mountain-mahogany, and snowberry, especially where these communities are interspersed with grasslands or meadows. Mountain lions also inhabit deep, rocky, vertical-walled river canyons containing riparian vegetation such as cottonwood and willows. As a large carnivore, the lion prefers large prey. Research indicates that 80% to 90% of a lion's diet is deer; on average, an adult with an established territory will kill one deer per week. Other prey species include elk and smaller mammals.

Game Birds

Small game includes upland game birds, such as greater sage-grouse, blue grouse, ruffed grouse, and mourning dove; and several species of waterfowl.

Greater Sage-Grouse

Greater sage-grouse are discussed below under Special Status Wildlife Species.

Forest Grouse

Blue and ruffed grouse are restricted to foothill and mountain areas and are found in association with aspen, conifers, and riparian vegetation. Blue grouse typically occur in elevations above 8,500 feet in mountains vegetated with aspen, fir, and spruce. Although they do not typically range too far from dense stands of cover, they often forage along abandoned logging roads and in meadow clearings, especially along the bases and tops of knolls and ridges. Typical food sources include plants (e.g., various berries, vetches, aspen leaves, dandelions, clover blooms, and buds) and insects. As these food sources diminish toward winter, blue grouse increasingly subsist on the needles and buds of Douglas fir and other conifers.

Of the two forest grouse species, ruffed grouse are more common. Ruffed grouse tend to occur in deciduous and mixed forests, especially those with scattered clearings and dense undergrowth. In the Rocky Mountain West, favored habitats tend to be in broadleaf aspen and riverine woods. The summer diet is varied and consists of insects, seeds, fruits, and even an occasional small snake or frog. The winter diet consists primarily of buds and catkins. In addition to undergrowth with some openings, drumming sites (e.g., logs, rocks, or other elevated sites) for males are required in breeding habitat. Typically, nests are in a shallow depression on dry ground, lined with leaves, and in the shelter of a fallen log, bush, rock, root, or low-hanging conifer limb, usually near the base of a tree.

Mourning Dove

Mourning doves are a common inhabitant throughout many areas (Dorn and Dorn 1990). No assessment of dove habitat conditions has been conducted for the planning area. The mourning dove occupies a broad range of plant communities, including desert areas, open mixed woodlands and wood edges, farm and ranchlands, shelterbelts, and grasslands. The mourning dove inhabits primarily woodland-grassland edge, prairies, and open forests but avoids densely forested regions. They are often attracted to disturbed areas supporting annual weedy plant species or to agricultural areas. They also are common in towns and cities. Generally, mourning doves nest 10 to 25 feet above the ground on horizontal branches of shrubs and trees having forks and large branches and in stands with low canopy cover. Although tree nests are most common, in their absence, mourning doves will readily nest on the ground. Mourning doves forage primarily on the ground and feed almost entirely on seeds of grasses, weeds, and cultivated grains. They also eat insects, snails, fruits, nuts, acorns, and pine seeds.

Waterfowl

The scattered aquatic resources in the Upper Green River Basin provide habitat for at least 24 species of waterfowl (USDI, BLM 1985). The amount and quality of aquatic habitats potentially suitable for waterfowl fluctuate yearly based on hydrologic conditions. Main waterfowl use areas in the north include the Upper Green River, its tributaries, and adjacent wetlands; the New Fork River and its tributaries; and the New Fork Pothole area. Main waterfowl use areas in the south include South Soda Lake and Fontenelle Reservoir and associated waterbodies. The most abundant species found include canvasback, mallard, green-winged teal, northern pintail, and ring-necked ducks, common goldeneye, and common merganser. Large portions of the waterfowl populations are migrants.

Portions of the Green River and its tributaries and the New Fork Potholes area provide habitat for populations of nesting waterfowl. The New Fork Potholes may be a significant nesting area for the canvasback duck. However, waterfowl nesting habitat in the planning area typically is not abundant because of the low availability of water and lack of dense vegetative nesting cover adjacent to shorelines. Most available water bodies in the planning area provide staging and migration stopover habitat for waterfowl. Winter populations are minimal as a result of climatic conditions that freeze waterways, making them unavailable to waterfowl during winter months.

Trumpeter swans are discussed below under Special Status Wildlife Species.

Small Game Mammals

Three species of small mammals are harvested as game animals: cottontail rabbit, snowshoe hare, and red squirrel. No assessments of habitat condition, estimates of population size, mortality or natality rates, or hunter effort are known for any of these species.

Furbearers

Several furbearer species occur. Population figures are available only on a statewide basis. Badgers are widely distributed throughout the planning area and feed mostly on burrowing rodents. Beavers are common along perennial watercourses and build lodges of sticks and mud, which serve as a source of shelter, food, and rearing of young. Bobcats occur in most habitats except high mountain areas, and populations are thought to be stable. Bobcats feed on small mammals, particularly rabbits and hares. Mink are common in riparian habitats and feed on small mammals, birds, insects, and other small animals. Muskrats are common in marshes, ponds, and other areas with shallow, slow-moving vegetated water. They feed primarily on aquatic plants, but mollusks, fishes, and upland vegetation are also consumed. Marten occupy the forested regions in mountains along the perimeter and may also be found along some portions of the Green and New Fork rivers between Highways 191 and 189 north of Highway 351 (WBN 1996). Red fox can be found throughout the area and eat a wide variety of foods (e.g., small mammals, birds, insects, and carrion).

Nongame Species

The diverse habitats provide for a multitude of nongame species. One of the most visible nongame mammals is the coyote. The coyote, which is considered a scavenger and predator but most often a pest because of attacks on pets, livestock, and young wildlife, can be found in all habitats.

Birds

More than 400 avian fauna species have been documented in Wyoming; 73 of these use riparian habitats. Most of the avian species are classified as passerine or songbirds, and more than half of these are considered year-round residents. Most songbird populations in the area are adapted for open areas. The vast sagebrush component of the planning area provides crucial habitat for major indicators of that type—namely, sage thrasher, Brewer's sparrow, and sage sparrow. Forest, riparian, and water resources also provide requisite habitats for multitudes of other species. Protection for most avian species comes under the Migratory Bird Treaty Act (MBTA) (16 USC 703-711) (CFR 2001) and Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (66 FR 3853). Federal agencies are directed to focus on issues such as restoring and enhancing habitat and avoiding or minimizing adverse impacts on migratory bird populations.

Raptors

Raptors are high trophic level predators, which are good indicators of habitat quality. Common raptors include golden eagle, red-tailed hawk, sharp-shinned hawk, Cooper's hawk, northern harrier, prairie falcon, American kestrel, northern saw-whet owl, great horned owl, and long-eared and short-eared owls. The osprey is one of the most visible raptors along the river corridors. Wintering raptors may include the rough-legged hawk and the snowy owl. Raptors that are federally listed or BLM Sensitive Species are discussed in those sections.

Nesting may take place in various habitats, but often nest site selection depends on prey availability, habitat quality, and the level of raptor populations and competition (inter- and intraspecies). Nesting raptors typically exhibit fidelity to a nesting territory and may be present for years. Tolerance levels to

disturbance can be species specific. Responses of nesting raptors to human disturbances are generally determined by the type, duration, magnitude, noise level, and timing of activity relative to nesting phenology. Raptors that successfully nest during a disturbance may abandon the nesting territory the year following the disturbance (USFWS 2002).

Ravens are common in the planning area. Ravens are opportunistic and intelligent. They are scavengers, feeding on carrion; eggs, including sage-grouse eggs; and garbage. Studies are being conducted to determine the extent of raven predation on sage-grouse chicks. Wyoming classifies ravens as a pest; however, they are protected by the MBTA.

Mammals

The planning area is inhabited by at least 42 species of nongame mammals, including 5 species of shrews, 12 species of bats, 9 species of the squirrel family, 2 species of gophers, 14 species of mice/rats, and porcupines (Clark and Stromberg 1987).

Reptiles and Amphibians

Although the climate and habitat types found in the planning area restrict the diversity and abundance of reptiles and amphibians, 10 species of reptiles and amphibians inhabit the area. These include tiger salamander, western boreal toad, Great Basin spadefoot toad, boreal chorus frog, northern leopard frog, Columbia spotted frog, eastern short-horned lizard, northern sagebrush lizard, rubber boa, and wandering garter snake.

Riparian and wetland habitats are the transition zones between terrestrial and aquatic ecosystems in which many of these species occur at least part of the year. These habitats include three vegetation categories: riparian forest, shrubland, and herbaceous meadow/wetland. Together, these three categories make up roughly 54,450 acres within the planning area. All of the salamander, toad, and frog species require quiet water for springtime breeding and are therefore seldom found far from ponds and transient pools. The spadefoot toad digs itself into soft earth. The frogs remain in marshy aquatic habitats year-round, but in the winter they hibernate in the mud. Of the three frog species, the Columbia spotted frog is the most aquatic, whereas the boreal chorus frog is the least aquatic and may occupy seasonally flooded areas with little year-around water. The two snake species, and especially the two lizard species, occupy drier habitats because they are not dependent on water for breeding. Nonetheless, the rubber boa and wandering garter snake are typically found in moist locations, with the boa frequenting coniferous forests and the garter snake frequenting grassy meadows. The eastern short-horned and northern sagebrush lizards occur in dry areas that may have clumps of brush, stumps, and surface litter or are rocky and may have scattered or no trees. The eastern short-horned lizard also may occur in areas of hardpan or otherwise consolidated crust and in sandy soils. No estimates of population size are available for any of these species.

Special Status Wildlife Species

U.S. Fish and Wildlife Service Designated Species

The following discussion contains information on the endangered, threatened, proposed, and candidate wildlife species for the PFO.

- **Black-Footed Ferret.** The black-footed ferret was designated as a USFWS endangered species in March 1967 under a precursor to the ESA of 1973 (*Federal Register* 1967). Black-footed ferrets are closely associated with prairie dog towns and rely almost entirely on these rodents as prey. Ferrets also use prairie dog burrows for denning and shelter. Prairie dog towns of 12.5 acres or larger are needed to support ferrets. In Wyoming, ferrets historically occurred in all nonmountainous areas of the state (Clark and Stromberg 1987). Black-footed ferrets were

considered extinct until a small population was discovered near Meeteetse, Wyoming, in 1981. Following outbreaks of distemper, surviving black-footed ferrets were brought into captivity and a captive breeding program was initiated. After a period of captive breeding, the USFWS began to reintroduce ferrets to the Shirley Basin in 1991. Ferrets have continued to persist in Shirley Basin, and wild-born ferrets were documented in 2000 in that reintroduced population.

- **Canada Lynx.** The Canada lynx was designated as a USFWS threatened species in April 2000 (*Federal Register* 2000). This large, snow-adapted cat is typically associated with high-elevation forested areas that support ample populations of snowshoe hares and other preferred prey species. The size of the lynx home range varies by the animal's gender, abundance of prey, season, and the density of lynx populations. The planning area is within the historic range of the lynx. The complexities of lynx life-history and lack of current lynx data for the contiguous United States make it difficult to ascertain the current population of lynx. Extensive potential habitat for this species occurs immediately adjacent to the planning area in the Wind River Mountains and the Wyoming Range. Canada lynx inhabiting these areas could be expected to range into the planning area. Lynx use woody debris, such as downed logs and windfalls, as denning sites with security and thermal cover for kittens.

- **Western Yellow-Billed Cuckoo.** In July 2001, responding to a petition to list the western yellow-billed cuckoo under the ESA, the USFWS determined that such a listing was warranted but precluded by higher-priority listing actions (*Federal Register* 2001). As a result, the western yellow-billed cuckoo has been designated as a Federal Candidate Species. It prefers large tracts of deciduous riparian woodlands with dense, scrubby undergrowth. It frequently uses willow thickets for nesting and forages among large cottonwoods (Bennett and Keinath 2001). In Wyoming, the western subspecies of the yellow-billed cuckoo is considered uncommon and is found primarily along waterways in the lower Green River Basin. The species has been documented within the planning area, but no known nest sites exist (WNDD 2002). Yellow-billed cuckoos eat primarily large insects such as caterpillars and cicadas, as well as frogs and lizards.

BLM Sensitive Wildlife Species

BLM defines Sensitive Species as species that could easily become endangered or extinct in a state unless protection is granted. The BLM Wyoming Sensitive Species Policy and List, which was established in April 2001 and updated in September 2002, provides guidance for consideration of species when undertaking actions on public lands. The intent of this list is to ensure that BLM's actions do not result in the listing of any species as candidate or threatened and endangered. Designated Sensitive Species are provided the same level of protection by the BLM as Federal Candidate Species.

Following are discussions on BLM Sensitive Species, except the western yellow-billed cuckoo and Columbia spotted frog, which were discussed previously.

- **Gray Wolf.** The gray wolf was designated as an endangered species in 1967. The availability of prey, especially large ungulates, is critical to habitat selection. In 2003, it was estimated that a least 76 to 88 wolves inhabit western Wyoming outside Yellowstone National Park. Roughly 8 packs, totaling 63 to 70 wolves, produced pups. In 2003, the wolf population increased 19% from 2002 levels (from 69 to 82 wolves) (USFWS et al. 2003). The Pinedale planning area provides habitat to gray wolf populations. The Black Butte pack uses the Upper Green River, the Daniel pack uses the Wyoming Range, and the Prospect pack occurs near Farson, Wyoming. These packs have all been managed by USFWS and the Wyoming Wildlife Services because of depredation of livestock. Some of these animals are collared and have been found to have large territories. The USFWS established a distinct population segment (DPS) of the gray wolf in the Northern Rocky Mountains and removed (delisted) this DPS from the Federal List of Endangered and Threatened Wildlife by final rule dated February 27, 2008, effective March 28, 2008.

- **Grizzly Bear.** The grizzly bear was listed as an endangered species in 1967 and subsequently reclassified as threatened in 1975. In Wyoming, grizzly bears currently occupy Yellowstone and Grand Teton National Parks and portions of adjacent national forest and private lands extending south in the Wind River Range to the Green River Lakes area (Moody et al. 2002). The Green River Lakes area is just outside the northern boundary of the planning area. At present, no occurrences of grizzly bears in the planning area have been confirmed. Potential habitat for them exists in forested regions of the Wyoming and Wind River Ranges along the perimeter of the planning area. Grizzly bears may occur within the planning area in the future if the southward expansion of northern populations continues. The USFWS established a DPS of the grizzly bear for the Greater Yellowstone Area and surrounding area and removed (delisted) this DPS from the Federal List of Endangered and Threatened Wildlife by final rule dated March 29, 2007, effective April 30, 2007.

- **Greater Sage-Grouse.** Greater sage-grouse are the most numerous and widespread game bird within the planning area, with year-round habitats in sagebrush-dominated areas. Greater sage-grouse require open areas within the sagebrush community for leks where they perform courtship rituals. These strutting grounds (lek sites) are considered "traditional" or "historic" because the birds return to them annually. After nesting, the hens move to brood areas that support forb understory or succulent vegetation (i.e., riparian areas or irrigated fields) and large populations of insects in late spring and late summer. The sage-grouse diet consists almost entirely of sagebrush during late fall and winter.

  Greater sage-grouse are dependent on sagebrush habitats year-round. The general distribution of greater sage-grouse is associated with the distribution of sagebrush (*Artemisia* spp.), and in particular, big sagebrush *(A. tridentata*) (Schroeder et al. 2004). Habitat loss and degradation, as well as loss of population connectivity, have been identified as important factors contributing to the decline of greater sage-grouse populations rangewide (Braun 1998, Wisdom et al. 2002). Therefore, any activities that result in loss or degradation of sagebrush habitats that are important to this species should be closely evaluated for their impacts on sage-grouse. Minimization of disturbance during lek activity, nesting, and brood rearing is critical to sage-grouse persistence within these areas. In Wyoming, information suggests that greater sage-grouse populations are negatively affected by energy development activities, especially those that degrade important sagebrush habitat, even when mitigation measures are implemented (Braun 1998, Lyon 2000). Greater sage-grouse populations can repopulate areas developed for resource extraction after habitat reclamation for the species (Braun 1987). However, there is no evidence that populations attain their previous levels, and reestablishment of sage-grouse in a reclaimed area may take 20 to 30 years, or longer (Braun 1998). Recent information from a doctoral dissertation on the impacts of oil and gas development on greater sage-grouse in the Pinedale Anticline revealed that as development increased, lek activity declined up to 100% (Holloran 2005).

  Sage-grouse have been extirpated from five states and one Canadian province, and populations over the remainder of its range have declined an average of 33% from 1985 to 1995 (Braun 1998; Connelly and Braun 1997). Conservative estimates suggest that 50% of the original area occupied by sage-grouse is no longer capable of supporting the species on an annual basis (Braun et al. 1976, Braun 1995). The current distribution of sage-grouse indicates that the remaining populations are increasingly isolated, often requiring translocations for support (Schroeder et al. 2004), indicating future issues in genetic flow and potentially the repopulation of historic habitats. Wyoming historically supports larger populations of greater sage-grouse than any other state because of its sagebrush habitats (Patterson 1952). The areas in central and western Wyoming where sagebrush-dominated landscapes and 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. No causative factors have been identified that explain population reductions throughout Wyoming, although changes in the sagebrush-dominated areas in which the birds typically reside are thought to be one of the principal factors (Braun 1998; Connelly and Braun 1997).

Existing BLM Field Office-wide and statewide policy restrict exploration and development activity within one-quarter mile of a lek. There are also timing stipulations protecting nesting and brood-rearing females and wintering grouse, but these stipulations do not preclude exploration and development from taking place in nesting and wintering habitat after the timing restriction. This causes severely fragmented habitats, and habitat treatments may not be effective mitigation to offset impacts of the initial development. Total shrub canopy cover, residual grass cover, nonfood forb cover, and litter cover are the best predictors of sage-grouse nesting habitat (Holloran 1999, Lyon 2000). When sagebrush habitats are degraded by occurrences such as wildland fires, clearing, or herbicide treatments, vegetation reestablishment may take several years. Mountain big sagebrush on productive sites may recover in 15 to 25 years and in some cases 30 years. Wyoming big sagebrush may require between 30 to 40 years to recover. Basin big sagebrush has intermediate recovery rates between these two species (Slater 2003, Braun 1998).

Sage-grouse breeding habitats are characterized by sagebrush 40 to 80 cm tall (Connelly et al. 2003). The average height of sagebrush most commonly used by nesting sage-grouse ranges from 11 to 32 inches (28 to 81 cm), and sagebrush canopy cover within sagebrush stands used for nesting generally ranges from 15% to 25% (Connelly et al. 2000). In Wyoming, Holloran (1999) found the mean height of nest shrubs to be 18.2 inches (46.4 cm), which was greater than the mean height of shrubs in the surrounding area. An analysis of sage-grouse nest site selection from seven study areas in Wyoming indicates that residual grass height should be a minimum of 3.9 inches (10 cm) in Wyoming big sagebrush dominated sites (Holloran et al. 2005). Optimum early brood habitat, similar to that of breeding, consists of sagebrush stands that are 11 to 32 inches (30 to 80 cm) tall, with a canopy cover of 10% to 25% and an herbaceous understory of 15% grass canopy and 10% forb canopy (Bohne 2007).

Most nesting habitat can be identified as patches of sagebrush with 15% to 30% canopy cover. Productive nesting habitats in Wyoming big sagebrush have an understory with an herbaceous canopy cover of at least 15%. Productive nesting habitat in mountain big sagebrush stands and mesic Wyoming big sagebrush should have at least 25% canopy cover for herbaceous vegetation. Suitable habitat is defined as sagebrush stands with at least 15% canopy cover of grasses and at least 10% canopy cover of a diversity of forbs. The average height of current year's growth should be at least 7 inches (18 cm) by early June. Residual grasses from the previous year provide cover for nesting at the time of nest site selection by the hen and should be at least 3.9 inches (10 cm) in height in potential nesting habitat in these two vegetation types (Bohne 2007).

During winter, sage-grouse feed on relatively short sagebrush, at least with respect to its height above snow (Connelly et al. 2003). It is critical that sagebrush be exposed at least 10 to 12 inches (25 to 35 cm) above snow level to provide food and cover for wintering sage-grouse (Bohne 2007).

Population Trends

Recent lek monitoring data have been obtained through surveys conducted during the 2002–2006 time period, and included in the *2006 Sage-Grouse Job Completion Report—Upper Green River Basin Summary*, prepared by the Wyoming Game and Fish Department.

Current Status and Short-term Trends

All but 13 of the 119 known occupied sage-grouse leks (97%) in the Upper Green River Basin

were checked during 2006. This compares with 98%, 78%, 80%, 60%, and 62% checked during 2005, 2004, 2003, 2002, and 2001, respectively. With increased lek monitoring efforts over the past few years, a total of 12 new leks were located during the 2004–2006 breeding seasons. Of the 106 leks checked in 2005, 87% were lek counts and 13% were lek surveys. The percentage of leks for which count data were collected has continued to increase from 41 in 2001 to 73 in 2004. Results from the counts and surveys showed that 74 (70%) leks were active, and 32 (30%) were inactive. The average number of males/lek for all active leks has continued to increase the last 3 years from 21 in 2003, to 24 in 2004, to 35 in 2005, and 46 in 2006. Generally, the proportion of leks checked that were active has gradually declined from 2001 to 2006. Data from the lek searches in 2001 showed 88% of the leks were active, while 70% were active during 2006. Part of this decline can be attributed to increased abandonment in areas with increased gas development activity.

Lek Complexes

There are currently 25 known occupied lek complexes in the Upper Green River Basin for a total of 125 leks (includes unknown and unoccupied leks). During 2005, 24 of 25 lek complexes (96%) were documented as "active." A total of 21 (84%) lek complexes were counted (count data collected) in 2006, which is similar to the previous 3 years (2002–2005), and much better than the 10 counted in 2001. All the counted lek complexes in 2006 had at least one active lek. An average of 146 males per complex was observed in 2006, which is significantly higher than any of the previous 4 years. Average counts during 2001–2005 were 117, 79, 57, 88, and 134, respectively. Of the 24 lek complexes that were checked (counts and surveys combined) in 2006, the average number of males/complex was 143. This is an increase of 14 males/complex compared with 2005 and an increase of 60 males/complex compared with 2004.

Brood Count Surveys

One permanent brood survey route has been established on Muddy Creek near the Bench Corral elk feedground. Surveys for the past 5 years documented 8 hens, 1 chick, and 2 males in 2002; 5 hens, 3 chicks, and 2 males during 2003; 13 hens, 11 chicks, and 2 males in 2004; 13 hens and 32 chicks in 2005; and 19 hens and 33 chicks in 2006.

Sage-grouse research has been ongoing in the Upper Green River Basin for 9 years, which provides very good nest establishment, nest success, and brood production data. Of 113 radio-collared hens (yearlings and adults) in 2006, 100 (88%) birds initiated nests. Nest success was 51% in 2006, 62% in 2005, 63% in 2004, 45% in 2003, and 40% in 2002. Brood count data (collected in July) from these hens with successful nests showed an average brood size of 2.6 chicks per brood in 2006, compared to 3.2 in 2005 and 2.9 in 2004. The ratio of chicks to total hens (successful and unsuccessful hens combined) was 0.77 in 2006, 0.85 in 2005, 0.81 in 2004, 0.58 in 2003, and 0.55 in 2002.

Population Trends and Estimates

No reliable population estimate can be made from data collected during 2006 (or any of the previous years) because sex ratios for grouse are unknown and not all active leks have been located. An increasing population trend during 2004–2006 is indicated by an increase in the average number of males/lek and males/complex since 2003.

- **Long-Eared Myotis.** The long-eared myotis is frequently found roosting under the bark or within cavities of ponderosa pine trees during the daytime, although it can also be found at much higher and lower elevations. The long-eared myotis likely is scattered throughout the planning area where suitable roost sites exist. This species was also confirmed in 2001 in the Jonah Field along Sand Draw in 29N R108 Section 28. Luce et al. (1997) reported this species as occurring in the planning area.

- **Pygmy Rabbit.** The pygmy rabbit is the only rabbit native to North America that digs its own burrows. It also is uniquely dependent on sagebrush, which makes up most its diet; however, other vegetation is also consumed. Dense sagebrush and relatively deep, loose soils are important characteristics of pygmy rabbit habitat (Green and Flinders 1980). Breeding occurs during the spring and early summer; females may produce a litter of about six young. This species was reported during the 1970s and 1980s south of Pinedale and west of Fontenelle Reservoir (WNDD 2002).

- **White-Tailed Prairie Dog.** The white-tailed prairie dog is found in central and southwestern Wyoming (Map 3-22) and inhabits various grassy habitats, including mountain valleys, mesas, and shrubby and semidesert grasslands (Clark et al. 1971). Distribution is variable, and many areas have not been surveyed. White-tailed prairie dogs form colonies and spend much of their time in underground burrows, often hibernating during the winter. The species breeds in the spring, and young can be seen aboveground in early June. Their diet is composed of grasses and bulbs. In turn, the white-tailed prairie dog is the main food source of the endangered black-footed ferret. Major threats to the white-tailed prairie dog include habitat loss, poisoning, and the plague.

- **Idaho Pocket Gopher.** The Idaho pocket gopher has been found in subalpine mountain meadows, shrub steppes, and various grasslands, but appears to favor rocky, shallow soils. Idaho pocket gophers have been documented near Big Piney and in the extreme eastern region of the planning area (WNDD 2002).

- **White-Faced Ibis.** The white-faced ibis has been confirmed as nesting in the planning area (Luce et al. 1997). They also have been documented north of Fontenelle Reservoir (WNDD 2002) and have been observed near Big Piney during the spring migration.

- **Trumpeter Swan.** Fond of lakes, ponds, marshes, and other wetlands areas, trumpeter swans are found in Wyoming in the extreme eastern and western regions. This species summers southwest of Boulder and winters in the southeast region if open water persists. Larger wintering populations were known from the central Atlantic coast of the United States, the Gulf of Mexico, the Ohio and Mississippi River Valleys, and parts of the West Coast (WNDD 2002). According to Luce et al. (1997), trumpeter swans have been observed in the planning area. Trumpeter swans have been periodically released on public land in the New Fork Potholes area. Currently the native reproducing population has been more successful at producing cygnets than the historic Snake River breeding population.

- **Northern Goshawk.** The limited amount of forested areas in the planning area indicates that few nesting goshawks are present. However, they have been confirmed as nesting (Luce et al. 1997) and are known to winter east of Pinedale, north of Fontenelle Reservoir, and in the southeast region (WNDD 2002).

- **Ferruginous Hawk.** Ferruginous hawks construct their big, bulky nests on the ground or occasionally in lone trees or on rock ledges. They will nest only in areas with abundant prey, typically small rodents. During winter, ferruginous hawks are often found around colonies of prairie dogs, which make up much of their winter diet (Woffinden and Murphy 1983). The species is uncommon and is known to breed in scattered locations, especially areas southwest of Boulder and north of Fontenelle Reservoir. Small numbers are known to winter near Pinedale and in the southeast portion of the planning area (WNDD 2002).

- **Bald Eagle.** The bald eagle was listed as an endangered species in 1967 and subsequently reclassified as threatened in 1995. They generally occur in areas with open water and near concentrations of winter ungulates, waterfowl, and/or fish. Bald eagle nesting habitat is defined as any mature stand of conifer or cottonwood trees in association with rivers, streams, reservoirs,

lakes, or any significant body of water. Although their main food item is fish, additional food items may include ducks, coots, rabbits, carrion, and small rodents. Bald eagles are sensitive to various human activities. Responses to human disturbance vary and may include short-term, temporal, or spatial avoidance of the disturbance, to total reproductive failure and abandonment of breeding areas (BLM, Buffalo Field Office). Seven bald eagle nests are known to occur scattered throughout the planning area. Wintering bald eagles have been observed at the Fontenelle Reservoir, near Pinedale, west of Daniel, southwest of Boulder, and in the southeast area (WNDD 2002). The USFWS removed (delisted) the bald eagle in the lower 48 states of the United States from the Federal List of Endangered and Threatened Wildlife by final rule dated July 9, 2007, effective August 8, 2007.

- **American Peregrine Falcon.** In 1999, this species was removed from the USFWS Endangered Species List (*Federal Register* 1999). Peregrine falcons nest on high cliffs, trees, high riverbanks, towers, and tall buildings (Savage 1992). This species is considered uncommon in the planning area, but some nesting has occurred (Luce et al. 1997). Peregrine falcons have been released on public lands near the Upper Green River.

- **Long-Billed Curlew.** Long-billed curlews usually nest in prairie and grassy meadows near water but occasionally choose dry upland sites. This species nests in scattered areas throughout the northern half of the area and near Fontenelle Reservoir (WNDD 2002). Luce et al. (1997) confirmed breeding of this species.

- **Burrowing Owl.** The burrowing owl is a BLM and USFS Sensitive Species and a WGFD Species of Special Concern. Burrowing owls nest in grassland, scrub, and steppe areas, usually using burrows excavated by other animals (Martin 1973). The burrowing owl is known to nest throughout the central and eastern regions of the planning area (WNDD 2002).

- **Sage Thrasher.** The sage thrasher nests in large, open tracts of dry shrub and grassland with dense stands of sagebrush, bitterbrush, or rabbitbrush. This species is known to nest west of Daniel, south of LaBarge, and southwest of Boulder (WNDD 2002).

- **Loggerhead Shrike.** The loggerhead shrike generally prefers open country with shrubs and low trees for nesting and spiny shrubs for impaling prey items (Porter et al. 1975). This species has been documented north of Fontenelle Reservoir (WNDD 2002). Luce et al. (1997) reported confirmed nesting of this species.

- **Brewer's Sparrow.** The Brewer's sparrow is listed as a BLM Sensitive Species that breeds in high-elevation shrubs and thickets and in sagebrush deserts. Brewer's sparrows are known to nest in the north region, west of Daniel, southwest of Boulder, north of Fontenelle Reservoir, and in the extreme east (WNDD 2002).

- **Sage Sparrow.** The sage sparrow is a BLM Sensitive Species that nests in large tracts of arid shrub and sagebrush communities. This species is known to nest west of Daniel, south of LaBarge, and southwest of Boulder (WNDD 2002).

- **Western Boreal Toad.** Western boreal toads can be found breeding in wet meadows, ponds, marshes, and other shallow waters in spring. In summer, this species uses upland montane sites, usually within 300 to 1,500 feet of the breeding ponds. During hibernation, western boreal toads seek shelter under rocks or logs, or in rodent burrows (Keinath and Bennett 2000). In 2000, several adults, tadpoles, and metamorphs were discovered downstream of the confluence of the Middle and South Sawmill Creeks on BLM-administered land, about 10 miles northwest of La Barge. This species also has been found in the central and east-central regions (WNDD 2002).

- **Northern Leopard Frog.** Suspected breeding sites for this species exist in the central and east-central regions (WNDD 2002). Luce et al. (1997) reported observations of the species but did not report confirmation of breeding.

Considerations for Other Wildlife Species

The USFS and WGFD also maintain lists of wildlife species considered sensitive or of special concern. In some cases, these species have been included on the BLM Sensitive Species list. Most of the species on the USFS and WGFD lists have documented occurrences within the planning area, but the extent of the populations on BLM-administered lands is unknown. Some species listed as sensitive by USFS or as of special concern by the State of Wyoming are not listed by BLM as a result of significant habitat or range differences. The known status and distribution of those species are discussed below.

- **Water Vole.** The water vole is a USFS Sensitive Species and a WGFD Species of Special Concern. It lives in semiaquatic habitats of subalpine meadows and alpine areas. This species lives near water, generally along stream and creek banks or around flooded marshes. The water vole is found more often in old-growth stands than in mature forest stands. Populations of this species are found in areas with a high percentage of exposed soil and a low percentage of canopy cover (Doyle 1987). There is confirmed breeding of water voles in areas in which potential habitat for this species occurs along the periphery of the planning area (Luce et al. 1997).

- **Wolverine.** The wolverine is a USFS Sensitive Species and a WGFD Species of Special Concern. They have been found in various habitats but are most commonly associated with boreal forest and tundra areas. This species has been reported near Boulder Lake and Cora (WNDD 2002).

- **River Otter.** The river otter is a WGFD Species of Special Concern. They are found in largely undisturbed riparian areas and may range up to 40 miles in search of food such as fish, crayfish, frogs, clams, salamanders, snails, turtles, snakes, insects, muskrats, and birds. River otters nest in burrows and caves and are mostly nocturnal. Natural populations of this species occur in the Green River Basin.

- **Harlequin Duck.** The harlequin duck is a USFS Sensitive Species and a WGFD Species of Special Concern. It breeds along small, clear turbulent streams and rivers with a high abundance of aquatic invertebrates. Nests are constructed under cover on cliffs along the shore and occasionally in tree cavities. The species has been confirmed breeding in the western half of the planning area and has also been observed in the eastern portion.

- **Merlin.** The merlin is a USFS Sensitive Species and a WGFD Species of Special Concern. In Wyoming, the species typically found is Richardson's merlin, the prairie species. Merlins nest in the canopy of large trees, often in association with old nests of other birds. They seem to prefer coniferous forests for nesting but also will use various mature forested habitats. Preferred habitats are usually intermixed with suitable foraging areas, such as shorelines, meadows, and recently cleared areas (DeGraaf et al. 1991). The Richardson's merlin is a year-round resident in Lincoln and Sublette counties, although many birds migrate south for the winter. Luce et al. (1997) report confirmation of breeding merlins in the planning area. This species has also been known to winter in the southeast region of the planning area (WNDD 2002).

- **Arctic Peregrine Falcon.** In 1999, this species was removed from the USFWS Endangered Species List along with the peregrine falcon (Fed. Reg. 1999). The arctic peregrine is considered a migrant in all counties in Wyoming. Peak migration periods in the state are April/May and September/October.

- **Forster's Tern.** Forster's terns nest along large marshes, estuaries, inland lakes, and reservoirs (Bergman et al. 1970). They are known to breed on the north end of Fontenelle Reservoir (WNDD 2002). The species has also been observed in the eastern portion of the planning area (Luce et al. 1997).
- **Black Tern.** Black terns nest along inland marshes and sloughs with fairly dense cattail (Typha spp.) or other marsh vegetation and pockets of open water. These wetlands are often shallow (Dunn and Agro 1995). Circumstantial evidence exists that black terns nest in Lincoln County within the planning area, and they also have been observed in the eastern portion of the planning area (Luce et al. 1997).
- **Northern Pygmy Owl.** Northern pygmy owls nest in coniferous and mixed forests containing open spaces and clearings. These owls frequently use old woodpecker cavities for their nests (Holt and Peterson 2000). According to Luce et al. (1997), northern pygmy owls have been confirmed as nesting in the planning area.
- **Great Gray Owl.** The great gray owl inhabits dense montane coniferous forests. They have been observed and are thought to possibly breed in the planning area (Luce et al. 1997).
- **Boreal Owl.** The boreal owl is a USFS Sensitive Species and a WGFD Species of Special Concern. They inhabit dense stands of mature coniferous trees in areas typically adjacent to small meadows. Because they cannot excavate their own nest sites, boreal owls frequently rely on cavities created by other species such as woodpeckers (Marco 1995). The boreal owl has been observed nesting near Big Piney (WNDD 2002). It may be a year-round resident of higher-elevation coniferous forests.
- **Lewis' Woodpecker.** Lewis' woodpecker is a USFS Sensitive Species and a WGFD Species of Special Concern. They use ponderosa pine forests; open riparian woodlands dominated by cottonwood; and mixed-conifer, logged, or burned pine forest. Luce et al. (1997) documented breeding in the planning area. It is possible that occasional overwintering by this species occurs.
- **Three-Toed Woodpecker.** The three-toed woodpecker is a USFS Sensitive Species and a WGFD Species of Special Concern. It nests in older, dense coniferous forests and in areas with natural clearings from disease, fire, or windfall (Yunick 1985). Luce et al. (1997) confirmed nesting of three-toed woodpeckers in the planning area.
- **Golden-Crowned Kinglet.** The golden-crowned kinglet is a USFS Sensitive Species. They nest in coniferous forests and are very active birds that frequently hover above the ends of tree branches in search of prey (DeGraaf et al. 1991). Golden-crowned kinglets are year-round residents of Lincoln and Sublette counties. Luce et al. (1997) confirmed nesting of this species in the planning area. Golden-crowned kinglets are also known to winter northeast of Pinedale and in the southeast region (WNDD 2002).

3.18.2 Aquatic Species

Fisheries in the planning area are restricted within the Upper Green River Basin above Fontenelle Reservoir. The reaches of the Green River and its tributaries in this area are moderately productive cold-water fisheries, with some reaches having limited fisheries potential. The area is currently managed as a trout fishery and serves as a key management area for the Colorado River cutthroat trout (CRCT) (the only native trout species in the planning area).

Many of the native species that were historically common throughout the area are either uncommon or have been extirpated. Several of the large Colorado River fishes, including the Colorado pikeminnow and

razorback sucker, may have periodically been found in stream reaches in the Pinedale area. However, the area was likely the extreme northern extent of their range, and no documented collections have been located for this area.

Fisheries Distribution

The majority of the planning area lies within the Upper Green River and New Fork River watersheds in the Green River Basin of the Upper Colorado hydrologic region. Additional portions of the area lie within the Big Sandy and Slate watersheds, also part of the Green River Basin and the Upper Colorado hydrologic region. A small area near Hoback Rim drains into the Snake River watershed. Watershed boundaries are illustrated and tabulated in Section 3.15 (Map 3-13).

Approximately 300 miles of stream and riverine habitat and 2,500 acres of lake and reservoir habitat occur in the planning area. However, not all of these areas support fish. Fisheries within the area consist of native and non-native game and nongame species. Several listed species or species of concern also are found within the area. Native fishes within the planning area have been greatly impacted by previous management actions. In September 1962, approximately 445 miles of the Green River and tributaries above Flaming Gorge Dam were poisoned with rotenone. In addition, hydromodification of the Green River and its tributaries for agricultural, mining, drilling, and recreational interests has played a role in the reduction of habitat for native fishes.

Productivity and Use of Fisheries

The WGFD classifies streams within the Green River Basin and planning area according to the relative productivity of each reach's trout fishery (States West 2000). The following four classifications are used to describe the quality of each river reach that has been assessed:

- Blue waters: Premium trout waters and fisheries of national importance with trout production greater that 600 pounds of trout per mile
- Red waters: Very good trout waters and fisheries of statewide importance with trout production of 300 to 600 pounds of trout per mile
- Yellow waters: Important trout waters and fisheries of regional importance with trout production of 50 to 300 pounds of trout per mile
- Green waters: Low-production water and fisheries of local importance with trout production of less than 50 pounds of trout per mile.

Within the planning area, no reaches are classified as blue waters. However, four reaches, three on the Green River above Fontenelle Reservoir and one on the New Fork River near Boulder, have been identified as red waters. The remainder of the stream and river reaches within the planning area have been classified as yellow or green waters, with some waters having no classification.

The WGFD has developed habitat quality indices for streams in the Pinedale area. These indicate that habitat quality in the Pinedale area is sufficient for maintaining game and nongame fisheries. However, the data provided appear to indicate that instream cover and water temperature values could be improved in some areas in the Pinedale region to enhance existing habitats. In 1988, supply and demand for fisheries resources in the Green River Basin above Flaming Gorge Reservoir indicated that total fishing demand was about 51% of the total supply for lakes and reservoirs in the basin (States West 2000). However, streams and rivers in the basin had about 91% utilization, whereas standing water had only 36% utilization.

Annual angler effort for standing water types (i.e., ponds, lakes, and reservoirs) in the Pinedale portion of the Green River Basin was estimated as 85,097 angler days by the WGFD (States West 2000). Of this

angler effort, 90% was in natural alpine (70% of total) and lowland lakes (20% of total). The remaining 10% of the angler effort was in alpine reservoirs (9% of total), lowland reservoirs (less than 1%), and trout farm ponds (less than 1%).

Annual angler effort for streams and rivers was not separated for the Pinedale portion. However, for the Green River Basin above Flaming Gorge Reservoir, angler effort has decreased during the past 20 years (States West 2000).

Water Quality Effects on Fisheries

The majority of the waters in the planning area are listed as Class 2AB waters by the Wyoming DEQ, Water Quality Division (WDEQ 2001a). Class 2AB waters are defined as those waters known to support game fish populations or spawning and nursery areas at least seasonally, perennial tributaries and adjacent wetlands, and areas in which game fishery and drinking water use is otherwise attainable (DEQ 2001a). Additional protections of Class 2AB waters include "non-game fisheries, fish consumption, aquatic life other than fish, primary contact recreation, wildlife, industry, agriculture and scenic values" (DEQ 2001a).

Other water quality designations within the planning area include Class 1 and Class 3B waters. Class 1 waters are defined as "outstanding waters" (DEQ 2001b). This designation is made for all waters for which water quality degradation, other than that originating from dam discharges, is not allowed. Class 3B waters include tributaries that are not known to support fisheries or drinking water supplies. They typically are intermittent or ephemeral in nature but have the hydrologic conditions necessary to support invertebrate populations, amphibians, and obligate or facultative wetland plant species.

Game Species

Game fish found within the planning area consist primarily of non-native species. However, several native salmonid species do exist within the Green River and Snake River drainages. The CRCT and the mountain whitefish are native to the Green River Basin. Geographically, CRCT are widely distributed throughout much of their historic range. However, populations have declined and are limited to smaller headwater tributaries. CRCT are no longer found in the larger river systems. Mountain whitefish are widely distributed throughout their historic range and are abundant. They reside in both smaller and larger river systems. The Snake River fine-spotted cutthroat trout is native to the headwaters of the Snake River drainage and has been introduced to areas within the planning area. A species similar to the Snake River fine-spotted cutthroat trout, the Yellowstone cutthroat trout, has also been introduced into the area. (However, it is still unresolved whether the Yellowstone cutthroat trout and the Snake River cutthroat trout are separate subspecies or are the same.) Additional game fish in the area include other introduced salmonids such as the rainbow, brook, and brown trouts.

According to WGFD data, native and non-native game fish populations generally are stable in the Pinedale area. Brown trout populations average between 125 and 300 fish per mile in the Green and New Fork Rivers, respectively. Brook trout populations average between 6 and 8 fish per mile for the New Fork and Green rivers. Rainbow trout populations vary and range from 16 fish per mile in the New Fork drainage to 245 fish per mile in the Green River. Much of the variation in these estimates could be attributed to the habitat availability in the Green River versus that in the New Fork River.

CRCT populations are stable and average between approximately 100 and 200 fish per mile throughout their current range in the Pinedale area, although individual streams vary from less than 50 per mile to more than 400 (Hirsch, Albeke, & Nesler 2006). The stability of these populations is attributed in part to the implementation of management objectives described in WGFD basin management plans. These plans identify specific strategies to ensure the survival of wild native fish stocks while providing consistent yields from recreational fisheries.

Nongame Species

Most of the fish species in the planning area are native or non-native, nongame species, including mottled sculpin, five species of suckers, redside shiners, three species of dace, carp, and several species of chub. Distribution and abundance of these species varies throughout the area. Generally, these species occupy the same water bodies as the game species. The nongame species are somewhat more adaptable to poorer water quality than are the game fish species, but are still negatively affected by habitat degradation such as erosion and sedimentation; wide temperature fluctuation; and decreases in food sources, suitable spawning sites, and cover.

Special Status Fish Species

Federally Listed Species

The USFWS listed the Kendall Warm Springs dace as endangered in 1970 (USDI, BLM 1982). The species is also listed as a Species of Special Concern by the WGFD. The species is not known to exist on BLM-administered lands in the planning area. Kendall Warm Springs dace is endemic to about 300 meters of Kendall Warm Springs, a small tributary to the Green River in the Bridger-Teton National Forest near the town of Pinedale. It is the only known species in Kendall Warm Springs.

Water flowing into the Green River drainage is considered a direct contributor to the habitat for four endangered fish species in the upper Colorado River. All water withdrawals from these tributaries are considered to adversely affect these species and require ESA Section 7 consultation with the USFWS. Water depletions and their effect on protected species are discussed in Chapter 4 (Section 4.17) and in the Pinedale BLM Draft Biological Assessment (2006).

- **Colorado Pikeminnow.** The Colorado pikeminnow (formerly known as Colorado squawfish) is listed as endangered under the ESA of 1973. In addition, the Colorado pikeminnow is listed as threatened by the State of Colorado and is legally protected by the State of Utah. Historically, the Colorado pikeminnow was abundant in the Colorado River and most of its major tributaries such as the Yampa River and the Green River.

- **Razorback Sucker.** Historically, the razorback sucker was well distributed in the Colorado River and in many of its major tributaries. Presently, it is listed as endangered under the ESA of 1973. In addition, the razorback sucker is listed as endangered in the State of Colorado, and it is legally protected by the State of Utah.

- **Bonytail.** The bonytail is listed as endangered under the ESA of 1973. In addition, it is listed as endangered in the State of Colorado and is legally protected by the State of Utah. Historically, the bonytail was abundant in the Colorado River and in its major tributaries such as the Green River and the Yampa River. At present, it is precariously extant in the Colorado River downstream of Lake Powell; it is nearly extinct upstream of Lake Powell.

- **Humpback Chub.** The humpback chub is listed as endangered under the ESA of 1973. In addition, it is listed as endangered by the State of Colorado and is legally protected by the State of Utah. Historically, it was abundant in the canyons of the Colorado River and in the canyons of four tributaries: the Green River, the Yampa River, the White River, and the Little Colorado River. Presently, two stable populations of humpback chubs are known to exist, both near the Colorado-Utah border: Westwater Canyon (Utah) and Black Rocks (Colorado). The largest known population exists in the Little Colorado River in the Grand Canyon. Smaller populations of humpback chubs can be found in the main stem of the Colorado River (Arizona) and in sections of its tributaries such as the Green River (Utah and Colorado) and the Yampa River near Dinosaur National Monument.

BLM Sensitive Fish Species

- **Roundtail Chub.** The species is endemic to the Colorado River Basin and historically commonly occurred in most medium to large tributaries of the Upper Colorado River Basin below elevations of 7,500 feet (Rees et al. 2005a). The taxonomy of the genus *Gila* continues to change because some subspecies have recently been reclassified as unique species (Rees et al. 2005a). Declines in abundance throughout the roundtail chub's range have been attributed mainly to the many forms of habitat degradation that followed the construction of dams throughout the Colorado River Basin, such as disruption of the natural flow regime, changes in the temperature and turbidity regimes, and channelization. In particular, the loss of natural flooding seems to limit roundtail chub recruitment (Brouder 2001), and low temperatures below reservoirs exclude roundtail chub from tailwater reaches (Vanicek et al. 1970). Declines in roundtail chub populations within the planning area can be attributed partially to September 1962, when 444 miles of the Green River and tributaries above Flaming Gorge Dam were poisoned with rotenone. Recovery of roundtail chub in this region has probably been hampered by the invasion of non-native fish species following the poisoning (Holden 1991). Within the planning area, roundtail chub distribution is not well documented. Suitable habitat likely exists from above Fontenelle Reservoir to Pinedale. Populations are known to occur in several mountain lakes above the town of Pinedale (Cavalli 2006). Once the Green River enters mountainous regions where water temperatures drop, habitat likely becomes unsuitable for roundtail chub. Surveys are needed to determine the present distribution of roundtail chub in the planning area.

- **Leatherside Chub.** According to Johnson et al. (1995), the leatherside chub was once a candidate for federal protection under the ESA; however, at present, the species has no federal status. The leatherside chub is native to the southern and eastern Bonneville Basin (including Salt Lake and Provo Lake drainages) and upper Snake River above Shoshone Falls (Utah, Idaho, and Wyoming) and the Wood River drainage in Idaho. It has also been introduced into the Green River in Utah (Lee et al. 1980). This species has experienced declines and local extirpations in various parts of its range. Reasons for decline include impoundments, dewatering, siltation, and predation by introduced brown trout (Walser et al. 1999). The leatherside chub is not native to the Green River, so any leatherside chub found within the planning area would constitute an introduced population. Although documented occurrences of leatherside chub in the Green River are restricted to Utah (Lee et al. 1980), the prevalence of use of this species as a bait fish indicates that leatherside chub certainly could be in the Upper Green River in Wyoming. Surveys are needed to determine whether this species occurs within the area.

- **Flannelmouth Sucker.** The flannelmouth sucker's native range spans the entire Colorado River Basin, including the Green, Yampa, Gunnison, San Juan, and Little Colorado Rivers; the Gila River Basin; and the mainstream Colorado River (Lee et al. 1980). They have declined in number and distribution throughout their historic ranges, although they remain fairly abundant throughout the Colorado River Basin, in contrast to many native fishes in the region (Rees et al. 2005b). However, dispersal is an important component of this species' life-history, and aggregations of adults below dams during spawning season suggest that impoundments may be disrupting spawning migrations (Chart and Bergersen 1992; McKinney, Persons, and Rogers 1999). Furthermore, evidence of hybridization between the flannelmouth sucker and the introduced white sucker in the upper Colorado River Basin (Holden and Stalnaker 1975, Valdez 2002) indicates another threat to the integrity and persistence of this species; as of spring 2006, there is only one known population of flannelmouth sucker in Wyoming that has not been impacted by the introduced white suckers (Cavalli 2006). Within the planning area, flannelmouth sucker populations were severely reduced in 1962 when the Upper Green River and its tributaries upstream of Flaming Gorge Dam were poisoned with rotenone (Holden 1991). The surviving

populations above the dam have repopulated the area to their current levels. Flannelmouth sucker populations, or their hybrids with white suckers, are found in several mountain lakes above the town of Pinedale (Cavalli 2006). They are also likely found in the large to moderate stretches of river within the planning area (Map 3-23). However, the exact limits of their distribution upstream of Fontenelle Reservoir are not currently known.

- **Bluehead Sucker.** The bluehead sucker has an interesting distribution, occurring in the Colorado River from the Grand Canyon on up into its tributaries, including the Green, Yampa, Gunnison, and San Juan Rivers, but absent from the Colorado River below Grand Canyon, including the Gila River Basin. It is also native to the Bear and Weber River drainages and the Snake River upstream of Shoshone Falls (Lee et al. 1980). Recent studies suggest that bluehead sucker populations are declining throughout their historic range (Ptacek et al. 2005); potential threats include habitat degradation resulting from impoundment and dewatering. The presence of dams throughout the bluehead sucker's range may interfere with migrations as well as water temperature. Holden and Stalnaker (1975) collected white sucker and longnose sucker in the upper Colorado River Basin; competitive interactions with these two introduced species could also harm the bluehead sucker. Hybridization with flannelmouth and white suckers may also be threatening the integrity of this species in the upper Colorado River Basin (Holden and Stalnaker 1975), although the threat of hybridization is greatest with the white sucker. In spring 2006, only one population of bluehead sucker in the Green River drainage was free from the introduced white suckers (Cavalli 2006). Populations of bluehead sucker within the planning area were severely reduced in 1962 when the Upper Green River and its tributaries above the Flaming Gorge Dam were poisoned with rotenone (Holden 1991). After the poisoning, the bluehead sucker was found to be one of the dominant species below the Flaming Gorge Dam (Holden and Stalnaker 1975). The surviving populations above the dam have repopulated the area to their current levels. The current number of bluehead suckers in the Green River drainage is very low, and the distribution is limited (Cavalli 2006). Given its wide tolerance of habitat types, it is likely that this species could occur throughout the area. However, surveys are needed to determine whether interactions with non-native suckers have restricted the bluehead sucker's distribution in the Upper Green River.

- **Colorado River Cutthroat Trout.** CRCT is the only native Colorado River trout and one of only two native salmonids (the other being the mountain whitefish). It develops brilliant red, orange, and golden-yellow coloration, especially during spawning. The CRCT was once common in the Upper Green River and Colorado River watersheds, with approximately 21,400 miles of habitat in the western United States (Hirsch et al. 2006). Declines in CRCT distribution have been documented in a number of reports (CRCT Coordination Team 2006, Behnke and Zarn 1976, Binns 1977, Martinez 1988, Young 1995). Analysis of distribution data indicates that they currently occupy approximately 14% of its former range (Hirsch, Albeke, & Nesler 2006). CRCT exist in isolated subdrainages in Colorado (1,359 miles), Utah (1,111 miles), and Wyoming (552 miles) (Behnke 1992, Hirsch et al. 2006, Young 1995). They have hybridized with non-native salmonids in many areas, reducing the genetic integrity (CRCT Coordination Team 2006). Pure populations of CRCT have been extirpated from much of their historical range.

  "The CRCT is designated as a Species of Special Concern by Colorado and Wyoming, and a Tier I species in Utah (those species that are either federally listed or for which a conservation agreement has been implemented). Before 1995, this fish was a Federal Category 2 candidate species, but does not occur in the candidate list proposed by the U.S. Fish and Wildlife Service in 1996 (50 CFR Part 17, 61 FR 7600), as use of categories 1, 2, etc. was eliminated in this proposed rule. The CRCT is classified as a Sensitive Species by Regions 2 and 4 of the USFS and by the BLM in Colorado, Wyoming, and Utah" (CRCT Coordination Team 2006). CRCT have also been listed as a subspecies of "special concern" by the American Fisheries Society. A petition to

list the CRCT as endangered or threatened was filed with the Secretary of the Interior. To date, the USFWS has not listed the subspecies. Threats to the CRCT include continued hydromodifications and habitat fragmentation throughout its historic range; competition and hybridization with non-native salmonids; whirling disease; continued development of oil, gas, and mineral leases; grazing impacts; and numerous other natural and manmade threats.

In the Green River drainage, CRCT are restricted to areas above upstream migration barriers; populations are disjunct, and displacement by non-native salmonids has occurred (Bozek and Rahel 1991). According to WGFD data and basin management plans, CRCT populations are located in more than 10 basins in the planning area (Map 3-23), although there are more populations upstream from the planning area on land administered by the USFS (Hirsch et al. 2006). Within the planning area, populations or portions of populations occur in the North Piney Creek Basin (1), Dry Piney Creek Basin (2), South Piney Creek Basin (8), LaBarge Creek Basin (4), Beaver Creek Basin (1), Cottonwood Creek Basin (3), Muddy Creek Basin (1), Horse Creek Basin (2), and East Fork River Basin (1) (Hirsch et al. 2006). Within the planning area, 10 populations either are genetically unaltered or have not been tested but are anticipated to be unaltered. Within the East Fork drainage, the population in Irish Canyon Creek is known to be a wild and pure population and is of significant importance. Other important populations occur in the Rock Creek drainage and the Beaver Creek ACEC.

Populations of CRCT in these drainages appear to be stable. Population estimates provided by WGFD range in abundance from about 50 fish per mile in Pine Grove Creek in the Dry Piney Basin to nearly 2,000 fish per mile in Irish Canyon Creek. Ongoing protection of the CRCT includes implementation of management objectives outlined in the April 2001 *Conservation Agreement and Strategy for CRCT in the States of Colorado, Utah, and Wyoming* and a subsequent update in the June 2006 *Conservation Strategy for CRCT in the States of Colorado, Utah, and Wyoming*. These important management tools have identified measures necessary for conserving the genetic and demographic viability of the cutthroat.

3.19 SPECIAL DESIGNATIONS AND MANAGEMENT AREAS

3.19.1 Areas of Critical Environmental Concern

ACECs contain one or more resources that require special management and protection for maintaining the value of the resource and the area. Areas designated as ACECs may contain resources such as rare or sensitive archeological resources; habitat for endangered, sensitive, or threatened species; or rare geologic features.

ACEC designations indicate areas for which special management attention is necessary for protecting and preventing irreparable damage to important historic, cultural, and scenic values; for protecting fish or wildlife resources or other natural systems or processes; or for protecting human life and safety from natural hazards. Management is considered special if it is unique to the area and includes terms and conditions designed specifically to protect the values in the ACEC.

BLM recognizes that an ACEC has significant values and establishes special management measures to protect those values. The designation is a reminder that significant values exist that must be accommodated when future management actions and land use proposals are considered in the ACEC. Designation may also support a funding priority. The designation of ACECs is achieved only through the resource management planning process, either in an RMP or in a plan amendment.

Two existing ACECs are within the planning area:

- **Rock Creek.** The management objective for the 5,270-acre Rock Creek ACEC is to protect the Rock Creek drainage to ensure quality aquatic habitat for the CRCT and to provide crucial winter range for a portion of the Piney elk herd. This ACEC was designated in the 1988 RMP. Because oil and gas leases are issued in aliquot parts, the boundary stretches beyond the actual hydrologic unit of the Rock Creek drainage (Map 2-16). Land management actions within the drainage are more restrictive than those applied to the area that falls outside the watershed.

- **Beaver Creek.** The objectives for managing the approximately 3,590-acre Beaver Creek ACEC are to ensure quality aquatic habitat for the sensitive CRCT and to protect elk calving habitat. Beaver Creek was designated as an ACEC during the 1988 RMP planning process.

Both ACECs are located along the western portion of the planning area, as shown on Map 2-16.

3.19.2 Other Areas With Unique Resources

Several areas contain other types of unique resources, including unique plant communities, visual resources, remote and undeveloped areas, and unique wildlife habitats. These include the following:

Ross Butte Ecosystem. This ecosystem is dominated by a badlands landscape that is virtually roadless and offers wide scenic vistas similar to the Painted Desert of Arizona. The soils, which are barren and unstable, provide unique habitat for Wyoming BLM sensitive endemic plant species. Within this area is winter habitat for sage-grouse and mule deer. The area contains abundant archeological materials and unique sites considered important and sensitive to Native Americans. One TCP is known, and the landform types found in this system frequently contain other sensitive cultural resources. The area offers recreational opportunities for semiprimitive motorized activities and is currently experiencing uncontrolled OHV use, resulting in increased erosion that causes visual intrusions and can destroy sensitive plant habitat. This landscape, which is unique to the PFO area, offers substantial recreation potential, including hiking, mountain biking, wildflower viewing, and other activities. Reardon Draw, an ephemeral drainage within the proposed Ross Butte Special Designation and Management Area (SD/MA), is listed as “impaired” under Section 303(d) of the Clean Water Act. According to the list of

impaired or threatened water bodies, the cause of this impairment is physical degradation, and the silt resulting from this condition is considered a threat to wildlife and agriculture.

Several important cultural sites, including the Wardell Buffalo Trap (48SU301), are in the vicinity of Ross Butte. An overview study has been conducted that ties Ross Butte directly to the Wardell buffalo trap as a lookout and sacred site. Uncontrolled OHV use in the region may be affecting visual resource management and site integrity of many cultural resources, including NRHP-listed properties. The badlands formation is known to hold many fossils in the Wasatch and Green River Formations.

Miller Mountain. This ecosystem is a remote, largely roadless landscape consisting of steep foothills with a combination of sagebrush, aspen, and conifer vegetation types. This area is an extension of the Lake Mountain WSA viewshed and contains VRM Class II values. It is identified as elk parturition and crucial winter range, contains lynx analysis units, and is widely used for big game hunting. It also contains potential CRCT habitat in Miller and Coal Creeks. Numerous small perennial streams and sensitive riparian habitats occur throughout the area. The area offers recreational opportunities for semiprimitive motorized activities. Miller Mountain is rich in cultural history and includes an ancient pictograph site, historic Ft. Hill, and more recent stone sheepherder cairns that signified range boundaries.

Wind River Front. This landscape was formed by Pleistocene glacial events that formed world-class geologic features, including terminal and lateral moraines and potholes. Unique to this landscape are huge boulders randomly scattered across a backdrop of rolling sagebrush foothills. Several streams intersect this area with Wild and Scenic River (WSR) values, including three that meet the criteria for inclusion as WSR segments (see related section below). Semiprimitive motorized and nonmotorized recreation opportunities include hunting, rock climbing, wilderness trailheads, sightseeing, antler hunting, hiking, mountain biking, and fishing. The Wind River Front, which lies in the foreground of the Bridger Wilderness and its Class I airshed, encompasses migration corridors for big game and for crucial winter ranges for moose, elk, and mule deer. It also supplies wintering and breeding habitats for sage-grouse.

Trapper's Point. Trapper's Point is a major funnel, or bottleneck, for mule deer and pronghorn in their migrations to and from winter range. The bottleneck is formed by the Green River to the west and the New Fork River agricultural lands to the east. A recent upswing in residential development to the east compounds the definition and constriction of the bottleneck. The Upper Green River Cattle Association relies on this area for movement of cattle from desert to forest allotments and back. This tradition has occurred for almost 100 years. Going back further in time, one of the most significant archaeological sites within the planning area is in the heart of the bottleneck, attesting to its long tradition with pronghorn. The Trapper's Point Site, 48SU301, is a pronghorn kill and butchering site more than 6,000 years old. Numerous other cultural sites are concentrated in the area.

New Fork Potholes. This unique subsection of the Wind River Front contains nearly 100 glacial potholes, which are depressions formed by huge blocks of ice stranded in a field of glacial outwash materials. Upon melting, these blocks left depressions in the landscape, which today remain in the form of small lakes. Abundant waterfowl use the ecosystem for nesting and brood rearing and as a stopover point in their migrations. Reintroduction efforts for the trumpeter swan have been attempted in the past. Riparian vegetation surrounds the potholes, providing habitat for various wildlife, including neotropical birds, elk, deer, and moose. A portion of the region serves as crucial elk winter range. The area is accessible for semiprimitive motorized recreational activities.

CCC Ponds. During the Great Depression, the Civilian Conservation Corps (CCC) had a camp on the south end of Fremont Lake. The CCC's project was to construct an irrigation ditch to serve the county and some ponds to retain water. Through the cooperative efforts of the Pinedale Middle School, USFS, Sublette County Conservation District, and BLM, today this area has been set aside as a local recreation haven. Opportunities in the area include hiking, fishing, wildflower and wildlife viewing, and mountain biking. The Pinedale Pedestrian Pathway connects the area to Pinedale. Mule deer also cross through this bottleneck as they migrate across the south end of Fremont Lake. Beautiful mountain views are a

backdrop to this glacial landscape.

3.19.3 Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968 (WSRA) was passed to protect free-flowing rivers or river segments and their related outstandingly remarkable values (e.g., scenic, recreational, geologic, fish and wildlife, historic, cultural). The WSRA establishes three WSR classifications: Wild, Scenic, and Recreational. The BLM is required to evaluate all rivers located on land under its administration to determine whether the rivers are eligible and suitable for inclusion in the National Wild and Scenic Rivers System (NWSRS).

BLM has conducted a review of all BLM-administered public lands along waterways in the planning area for their eligibility and suitability for inclusion in the NWSRS (Appendix 24). The findings of the review have been used in this RMP revision.

3.19.4 Wilderness Study Areas

In 1964, the Congress passed the Wilderness Act, establishing a national system of lands for the purpose of preserving a representative sample of ecosystems in a natural condition for the benefit of future generations. Until 1976, most land considered for and designated as wilderness was managed by the USFS and NPS. With the passage of FLPMA in 1976, the Congress directed BLM to inventory, study, and recommend which public lands under its administration should be designated wilderness. In the 1988 Pinedale RMP ROD, the Scab Creek WSA was recommended for wilderness designation, and the Lake Mountain WSA was not recommended for wilderness designation.

In the interim, between the inventory that identifies suitable and eligible areas appropriate for wilderness designation and the actual congressional designation of a wilderness, BLM must manage the potential wilderness. BLM manages these potential wilderness areas as WSAs (USDI, BLM 1990b). During the time that the Congress considers an area for wilderness, which can be many years, designated WSAs require special management practices to preserve the wilderness characteristics that make the areas appropriate for designation. WSAs, established under the authority of Section 603(c) of FLPMA, are managed to preserve their wilderness values according to the IMP and will continue to be managed in that manner until the Congress either designates them as wilderness or releases them for other uses. Only the Congress can designate or release Section 603 WSAs, and their status will not change as a result of the PFO planning process.

Two WSAs are identified in the planning area: Scab Creek WSA, composed of 7,710 acres; and Lake Mountain WSA, composed of 13,490 acres (Map 2-16). The final document for each area (*Final Scab Creek Wilderness Study Report* [BLM 1981]; *Final Rock Springs Wilderness EIS* [BLM 1990b]) has been used in the PFO to help determine which areas are suitable for WSA designation. A summary of each WSA follows:

- **Scab Creek WSA.** This area was originally established and managed as a primitive area in 1975. In April 1985, the Scab Creek Instant Study Area was proposed by former president Ronald Reagan for addition to the National Wilderness Preservation System. The Scab Creek WSA adjoins the Bridger Wilderness in the Bridger-Teton National Forest, which lies to the east. Scab Creek WSA offers extraordinary natural wilderness features and ample opportunity for solitary wilderness experiences. The area was withdrawn from locatable mineral availability in 1970.

- **Lake Mountain WSA.** Lake Mountain WSA contains important elk winter range, as well as CRCT habitat. This WSA also contains a 100-acre area designated for collecting moss rock. However, a documented analysis has not been performed to determine whether this type of activity would be compatible with the IMP. Therefore, permits to extract moss rock will not be issued until such analysis is conducted or the WSA is designated as wilderness or released for

other multiple uses. Lake Mountain WSA was determined to be difficult to manage as wilderness; therefore, it was not recommended for designation as wilderness in the *Final Rock Springs Wilderness EIS* (USDI, BLM 1990b). Nonetheless, the BLM must manage the area as a WSA until such time as the Congress does or does not designate it as wilderness.

No congressionally designated wilderness exists within the planning area. No areas other than the existing WSAs have been identified to contain wilderness characteristics.