
CHAPTER 3—AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter characterizes the existing environment of the Rawlins Resource Management Plan Planning Area (RMPPA). Although all environmental resources are described to some degree, emphasis is placed on those resources that are managed by the Bureau of Land Management (BLM) or are substantially influenced by BLM's management actions. Further, one or more of the management alternatives under consideration in this Environmental Impact Statement (EIS) for the Rawlins Resource Management Plan (RMP) development process places emphasis on those resources that have the highest potential to be impacted. For ease of reference, the sections below are arranged alphabetically.

No new environmental data collection efforts were conducted on BLM-administered lands specifically for this RMP. The BLM uses the best data available at the time the document is prepared. Environmental components that would not be affected or that are not essential to the resolution of planning issues are not covered in detail. Certain information was unavailable for use in developing this plan, because inventories either have not been conducted or were not complete. However, conducting surveys and studies to obtain all unavailable information for inclusion in this EIS would require additional time frames and incur exorbitant costs.

When encountering issues related to unavailable information, it is appropriate to pose the question implicit in the Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] 1502.22[a]) on incomplete or unavailable information: Is this information "essential to a reasoned choice among alternatives"? While additional information would often add precision to estimates, the basic data and central relationships in the RMPPA are sufficiently well established that any new information would not likely reverse or nullify relationships. Although new information would be welcome, no missing information is essential to a reasoned choice among alternatives.

Changes Between the RMP Draft EIS and the Proposed RMP/Final EIS

Changes in this chapter that have occurred from the draft EIS to the final EIS are primarily inclusions of additional information that either more clearly describe specific areas within the RMPPA or incorporate more current and accurate data reflective of the area. Specific resource sections that have been updated include, but are not limited to, the socioeconomic, wild horse, vegetation, and wildlife sections.

Other changes in this chapter include the descriptions of areas that were not identified in the draft EIS. These are areas for which management actions have been incorporated into the final EIS that were not included in the draft EIS. New descriptions are primarily found in the following sections: Special Recreational Management Areas (SRMA) (Section 3.11.2), Special Designations and Management Areas section (Section 3.13), Wild and Scenic Rivers (WSR) (Section 3.13.4), and Wildlife Habitat Management Areas (WHMA) (3.13.2).

3.2 AIR RESOURCES

3.2.1 Climate

The climate of the RMPPA is classified as desert and semi-arid steppe, with areas of mid-latitude highland or alpine (Trewartha and Horn 1980; Martner 1986).

Steppe climate is characterized by large seasonal variations in temperature (cold winters and warm summers) and by precipitation levels that are low but still sufficient for the growth of short, sparse grass. The dryness of the mid-latitude steppe climate of southeastern Wyoming is caused by the area's distance from the Pacific Ocean, the main source of precipitation for storms in the western portion of the Rawlins Field Office (RFO). This aridity is intensified by the Sierra Nevada, Pacific Coast, and Rocky Mountain Ranges, which intercept the flow of humid coastal air. In addition, annual rainfall amounts can vary greatly from year to year.

Mountainous areas within the RMPPA are classified as alpine. Alpine climate is characterized by large variations in local climates depending on altitude and slope exposure, but it is generally a similar but cooler version of the nearby lowland climate (Trewartha and Horn 1980). Temperature and precipitation vary as a function of several factors, including season, time of day, and elevation.

Weather stations in the RMPPA include stations located in Encampment and Rawlins in Carbon County, Wamsutter in Sweetwater County, and Centennial in Albany County. Rawlins is located at an elevation of 6,736 feet and is in the western part of the RMPPA. Centennial is located at an elevation of 8,140 feet and is in the southeastern part of the RMPPA. Meteorological data available from the Rawlins weather station from 1951 through 2000 and from the Centennial weather station from 1948 through 2000 form the basis of the climate characterization below.

3.2.2 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 range from 43 degrees Fahrenheit (°F) in Rawlins to 40 °F in Centennial. Mean maximum summer temperatures are 80 °F in Rawlins and 74 °F in Centennial. Mean minimum winter temperatures are 14 °F in Rawlins and Centennial. Figure 3-1 shows mean monthly temperatures at Rawlins and Centennial (Western Regional Climate Center 2002). Figure 3-2 shows trends in temperature changes per decade across the United States. These data show that Wyoming has warmed about 0.25 °F per decade since 1966.

The mean maximum monthly temperatures in Rawlins and Centennial reflect over time a slight warming in Rawlins (Figure 3-3) and a very slight cooling in Centennial (Figure 3-4) (Western Regional Climate Center 2002).

3.2.3 Precipitation

High elevations generally experience greater amounts of precipitation than lower elevations. Mean annual precipitation is 9 inches in Rawlins and 14.5 inches in higher elevation Centennial. Mean annual precipitation in Rawlins ranges from 5 inches in dry years to 13 inches in wet years. In Centennial, mean annual precipitation ranges from 9 inches in dry years to 20 inches in wet years (Western Regional Climate Center 2002). Precipitation in western Wyoming has stayed about the same, although precipitation in eastern Wyoming has increased up to 0.6 inches per decade (NOAA Climate Prediction Center).

Figure 3-5 shows the mean monthly water content of precipitation in Rawlins and Centennial. Mean monthly precipitation varies from 0.5 to 1.4 inches throughout the year in Rawlins and from 0.8 to 1.7 inches in Centennial (Western Regional Climate Center 2002).

Mean total snowfall is 4.3 feet in Rawlins and 9.5 feet in Centennial, with the greatest snowfall occurring from November through April. Figure 3-6 shows mean monthly winter snowfall ranging from 7 to 8 inches in Rawlins and from 15 to 20 inches in Centennial (Western Regional Climate Center 2002). Figure 3-7 shows long-term precipitation changes nationwide.

Data for mean monthly water content of precipitation in Rawlins and Centennial since 1951 show a very slight precipitation increase (<0.3 inch) in most months in Rawlins (Figure 3-8) and a variable pattern in Centennial (Figure 3-9). Data for mean annual total water content of precipitation in Rawlins and Centennial since 1951 (Figure 3-10) show a very slight increase in precipitation in Rawlins and an extremely slight decrease in Centennial (Western Regional Climate Center 2002).

3.2.4 Dispersion

Atmospheric stability is a measure of the atmosphere's capacity to disperse pollutants. Although stability data are not available for the RMPPA, they are available for Rock Springs, Wyoming (about 100 miles west of Rawlins). Figure 3-11 shows that mean annual dispersion at Rock Springs is very strong to moderate less than 20 percent of the time, weak to very weak about 20 percent of the time, and fair more than 60 percent of the time (USDI, BLM 1999).

3.2.5 Wind Velocity

Wind speed and direction are highly variable because of the effect of local topography in the RMPPA. Wind data are often presented graphically by a "wind rose," which shows the occurrence frequency of wind speeds and wind directions. Figure 3-12 shows a wind rose for Centennial. In mountainous areas such as Centennial, local topography can strongly affect wind direction, particularly at night and under low wind speed conditions. Figure 3-13 shows a wind rose for Rawlins. The annual average wind speed in Rawlins is relatively strong at 12 miles per hour (Martner 1986), and annual wind direction is generally from the west-northwest, west, or west-southwest (USDI, BLM 1999).

3.2.6 Air Quality

Elements of air quality addressed in this analysis include ambient air quality concentrations, visibility, and atmospheric deposition. Regulations governing these air quality elements are provided in Appendix 4.

Ambient Air Quality Concentrations

Ambient air concentration refers to the amount of pollutants present in a volume of air, and it can be reported in units of micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) or in parts per billion (ppb). For comparison, both units are shown only in the ambient air quality standards tables in the Air Quality Technical Support Document (AQTSD). Data provided by the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ-AQD) are used to establish background air quality levels. Information collected from the nearest applicable monitoring stations indicate that current concentrations comply with applicable standards. However, current and complete data on the concentrations of criteria air pollutants for the RMPPA are not available. Ambient air concentrations of criteria air pollutants provided by the WDEQ-AQD for the Rawlins region are shown in Table 3-1.

Table 3-1. Concentrations of Criteria Air Pollutants—West-Central Wyoming, Rawlins

Pollutant/ Averaging Time	Measured Background Concentration ($\mu\text{g}/\text{m}^3$)	Percentage of Standards (%)		Data Source
		NAAQS	WAAQS	
Carbon Monoxide (CO)				
8-hour	1,381	14	14	Data collected by Amoco at Ryckman Creek for an 8-month period during 1978–1979, summarized in the Riley Ridge EIS (USDI, BLM 1983)
Nitrogen Dioxide (NO₂)				
Annual	3.4	3	3	Data collected at Green River Basin Visibility Study site, Green River, Wyoming, during January–December 2001 (ARS 2002)
Ozone (O₃)				
1-hour	169	72	72	Data collected at Green River Basin Visibility Study site, Green River, Wyoming, during June 10, 1998–December 31, 2001 (ARS 2002)
8-hour	147	94	94	
Particulate Matter (PM₁₀)				
24-hour	47 ^a	31	31	Data collected by WDEQ at Emerson Building, Cheyenne, Wyoming, 2002 (WDEQ)
Annual	16 ^b	NA ^b	32	
Particulate Matter (PM_{2.5})				
24-hour	15 ^c	42	23	Data collected by WDEQ at Emerson Building, Cheyenne, Wyoming, 2002 (WDEQ)
Annual	5	33	33	
Sulfur Dioxide (SO₂)				
3-hour	132	10	19	Data collected at LaBarge Study Area at the Northwest Pipeline Craven Creek site, 1982–1983
24-hour	43	12	17	
Annual	9	11	15	

^a 47 $\mu\text{g}/\text{m}^3$ is the first maximum concentration of PM₁₀.

^b On September 21, 2006, EPA announced final revisions to the National Ambient Air Quality Standards for particulate matter, which were published in the *Federal Register* on October 17, 2006, and took effect on December 18, 2006. The revisions strengthened the 24-hour PM_{2.5} standard from 65–35 $\mu\text{g}/\text{m}^3$ and revoked the annual PM₁₀ standard of 50 $\mu\text{g}/\text{m}^3$. EPA retained the existing annual PM_{2.5} standard of 15 $\mu\text{g}/\text{m}^3$ and the 24-hour PM₁₀ standard of 150 $\mu\text{g}/\text{m}^3$. After the final rule becomes effective, the State of Wyoming will enter into rulemaking to revise the Wyoming Ambient Air Quality Standards.

^c 15 $\mu\text{g}/\text{m}^3$ is the second maximum concentration of PM_{2.5}.

Data provided by the WDEQ-AQD.

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

Carbon Monoxide

Carbon monoxide (CO) data were collected at Ryckman Creek by Amoco in conjunction with the proposed oil and gas development of the late 1970s. Because CO data are generally collected only in urban areas where automobile traffic levels are high, recent data are often unavailable for rural areas (Table 3-1).

Nitrogen Dioxide and Other Nitrogen Compounds

For the criteria pollutant nitrogen dioxide (NO_2), concentration data were collected at the Green River Basin Visibility Study site from January to December 2001. Annual NO_2 concentrations were 3 percent of both the Wyoming Ambient Air Quality Standards (WAAQS) and National Ambient Air Quality Standards (NAAQS) (Table 3-1).

Monitoring of nitrogen-containing pollutants in Centennial and Rocky Mountain National Park shows that concentrations of nitric acid (HNO_3), nitrate (NO_3^-), and particulate ammonium (NH_4^+) are fairly low and are not increasing over time.

The Clean Air Status and Trends Network (CASTNet) has measured concentrations of nitrogen-containing pollutants (HNO_3 , NO_3^- , and NH_4^+) and sulfur-containing pollutants (sulfur dioxide [SO_2], sulfate [SO_4^{2-}]), and ozone [O_3]) in the United States since the late 1980s. There are three CASTNet stations in Wyoming (Centennial, Yellowstone National Park, and Pinedale) and several stations in Colorado, including one in Rocky Mountain National Park. CASTNet data are available for Centennial from 1989 and for Rocky Mountain National Park from 1995.

Figures 3-14 and 3-15 show mean annual CASTNet concentrations of nitrogen-containing pollutants in Centennial and Rocky Mountain National Park. Mean annual concentrations of HNO_3 are less than 0.5 ppb at Centennial (Figure 3-14) and less than 0.7 ppb in Rocky Mountain National Park (Figure 3-15). HNO_3 concentrations typically 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 are well below urban levels, concentrations are slightly above levels typical in remote areas.

Mean annual concentrations of NO_3^- are less than 0.2 ppb in Centennial and less than 0.4 ppb in Rocky Mountain National Park. NO_3^- concentrations are typically about 0.2 ppb in remote areas and 1 ppb in urban areas (Stern et al. 1973). Although NO_3^- concentrations are well below urban levels, concentrations in Rocky Mountain National Park are above levels typical in remote areas.

Mean annual concentrations of NH_4^+ are less than 0.3 ppb in Centennial and 0.4 ppb in Rocky Mountain National Park. NH_4^+ concentrations are typically 0.3 ppb in remote areas and 1.4 ppb in urban areas (Stern et al. 1973).

The Wyoming Air Resources Monitoring System (WARMS) has measured concentrations of NO_3^- and NH_4^+ in Wyoming since 1999. There are five WARMS stations in Wyoming: Centennial (discontinued in 2003), Buffalo, Sheridan, Newcastle, and Pinedale. Figures 3-16 and 3-17 show, respectively, that weekly concentrations of NO_3^- in Centennial are below $2 \mu\text{g}/\text{m}^3$ and that weekly concentrations of NH_4^+ are below $0.6 \mu\text{g}/\text{m}^3$. 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 to ambient air quality standards. In addition, there are questions concerning a lack of data consistency in WARMS.

Sulfur Dioxide and Other Sulfur Compounds

For the criteria pollutant SO_2 , data were collected in the LaBarge Study Area at the Northwest Pipeline Craven Creek site during 1982–1983 (Table 3-1).

More recent SO_2 data, as well as SO_4^{2-} data, were collected by CASTNet in Centennial and Rocky Mountain National Park, and by WARMS in Centennial.

Figures 3-18 and 3-19 show mean annual CASTNet concentrations of SO_2 and SO_4^{2-} in Centennial and Rocky Mountain National Park. Concentrations of SO_2 are 0.6 ppb or less in Centennial (Figure 3-18) and less than 0.6 ppb in Rocky Mountain National Park (Figure 3-19). SO_2 concentrations typically range from 1 to 10 ppb in remote areas and from 20 to 200 ppb in urban areas (Seinfeld 1986). SO_2

concentrations in Centennial and Rocky Mountain National Park are consistent with concentrations typical of remote areas.

Mean annual concentrations of SO_4^{-2} are below 0.8 ppb in Centennial and Rocky Mountain National Park. SO_4^{-2} concentrations are typically about 0.6 ppb in remote areas and about 2.5 ppb in urban areas (Stern et al. 1973). SO_4 concentrations in Centennial and Rocky Mountain National Park are consistent with concentrations typical of remote areas.

Figures 3-20 and 3-21 show weekly WARMS concentrations of SO_2 and SO_4^{-2} , respectively, in Centennial from mid-1999 to be less than $1.1 \mu\text{g}/\text{m}^3$; SO_4^{-2} concentrations alone are also less than $1.5 \mu\text{g}/\text{m}^3$ but are closer to that value. It would be inappropriate to compare weekly WARMS concentrations directly with mean annual concentrations.¹

Ozone

Ozone concentration data were collected at the Green River Basin Visibility Study site from June 10, 1998, to December 31, 2001. O_3 concentrations were 94 percent of the WAAQS and NAAQS 8-hour standard (Table 3-1).

Ozone levels of concern (LOC) have been estimated for several areas, including the Bridger Wilderness in Wyoming (Fox et al. 1989). Estimated total deposition LOC include the “red line” (defined as the ozone concentration the area can tolerate) and the “green line” range (defined as the acceptable level of ozone). The ozone LOC for Bridger includes the green line (set at 35–75 ppb/year).

CASTNet stations in Pinedale, Centennial, and Rocky Mountain National Park also collected O_3 data. Figure 3-22 shows that mean annual O_3 concentrations have remained steady in Centennial since 1989 and in Rocky Mountain National Park since 1995, which is typical of remote areas in the western United States (Singh et al. 1978), and are within the LOC as an acceptable level of ozone (green line range).

Particulate Matter

Particulate matter (PM_{10} , $\text{PM}_{2.5}$) concentration data were collected in Cheyenne, Wyoming, in 2002. PM_{10} concentrations were 32 percent or less than the existing WAAQS and NAAQS. $\text{PM}_{2.5}$ concentrations were 33 percent or less than the existing WAAQS and NAAQS (Table 3-1). On September 21, 2006, EPA announced final revisions to the NAAQS for particulate matter, which were published in the *Federal Register* on October 17, 2006, and took effect on December 18, 2006. The revision strengthened the 24-hour $\text{PM}_{2.5}$ standard from 65–35 $\mu\text{g}/\text{m}^3$ and revoked the annual PM_{10} standard of 50 $\mu\text{g}/\text{m}^3$. EPA retained the existing annual $\text{PM}_{2.5}$ standard of 15 $\mu\text{g}/\text{m}^3$ and the 24-hour PM_{10} standard of 150 $\mu\text{g}/\text{m}^3$. After the final rule becomes effective, the State of Wyoming will enter into rulemaking to revise the WAAQS.

Hazardous Air Pollutants

Hazardous Air Pollutants (HAP) data do not exist for the RMPPA. 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, HAP emissions will be addressed in Section 4.2, Air Resources.

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 to ambient air quality standards. In addition, there are questions concerning a lack of data consistency in WARMS.

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 six IMPROVE aerosol monitoring stations in Wyoming: Brooklyn Lakes (near Centennial), Bridger Wilderness (near Pinedale), Yellowstone National Park, North Absaroka Wilderness (near Dead Indian Pass), Cloud Peak, and Thunder Basin. Of the six stations, the Bridger Wilderness and Yellowstone National Park stations are located within PSD Class I areas. 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 terms of deciviews (dv), a measure for describing perceived changes in visibility. One dv is defined as a change in visibility that is just perceptible to an average person, about a 10-percent 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:

- **Twenty Percent Clearest.** Mean visibility for the 20 percent of days with the best visibility
- **Average.** Annual mean visibility
- **Twenty Percent Haziest.** Mean visibility for the 20 percent of days with the poorest visibility.

Figure 3-23 shows annual visibility in Rocky Mountain National Park since 1991. Visibility on the 20 percent clearest days varies from 1.8 to 4 dv (visual range of about 150 to 190 miles). Average visibility varies from 7 to 9 dv (about 100 to 114 miles). Visibility for the 20 percent haziest days varies from 12 to 16 dv (about 50 to 70 miles). Trend analysis of Rocky Mountain National Park visibility data reveals no significant worsening of visibility since 1991. Figure 3-24 shows annual visibility in the Bridger Wilderness since 1989. Visibility on the 20 percent clearest days varies from 1.6 to 3.5 dv (visual range of about 160 to 190 miles). Average visibility varies from 5 to 7 dv (about 114 to 135 miles). Visibility for the 20 percent haziest days varies from 9 to 12 dv (about 72 to 94 miles). Also, for comparison, Figure 3-25 provides the reconstructed fine mass data (1-year average) for Rocky Mountain National Park since 1991. As with the visibility data, no upward trend was noted.

An IMPROVE monitoring station visibility station was installed in 2001 near Centennial (Brooklyn Lakes). The visibility data through 2004 include the following ranges:

- **Twenty Percent Clearest Days.** 184–201 miles
- **Mean Days.** 124–133 miles
- **Twenty Percent Haziest Days.** 85–78 miles.

These data indicate that visibility was better than that measured in Rocky Mountain National Park in 2001, but was in the range of visibility measured in Rocky Mountain National Park over the past 10 years. Visibility data from the Long-Term Study (Wyoming 2003) suggest that visibility is comparable to visibility at other sites around Wyoming.

Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited in terrestrial and aquatic ecosystems. It is reported as the mass of material deposited on an area (kilograms per hectare [kg/ha]) per year (-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). Substances deposited include—

- Nitrogen and sulfur compounds (nitrates, nitrites, and sulfates and sulfites)
- Acids, such as sulfuric acid (H₂SO₄) and HNO₃; 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^+ .

Estimation of atmospheric deposition is complicated by contribution to deposition of several components: 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). There are eight NADP stations in Wyoming. Figure 3-26 shows the precipitation acidity (pH) in the Snowy Range, Brooklyn Lakes, and South Pass City through 2002. The natural acidity of rainwater is generally considered to have a pH of 5.0–5.6 (Seinfeld 1986). Precipitation pH in Wyoming ranged from 5.0 to 5.3 in 2004. Areas of significantly lowered precipitation pH (4.6–4.3) are mainly in the northeastern United States (Figure 3-27). Precipitation pH in the Snowy Range, Brooklyn Lakes, and South Pass City has been above 4.8 since 1989.

Figures 3-28 and 3-29 show mean annual wet deposition of NH_4^+ , NO_3^- , and SO_4^{2-} at the Snowy Range and Brooklyn Lakes NADP stations. Wet ammonium deposition values are low (below 2.0 kg/ha-yr) in the Snowy Range and in Brooklyn Lakes.

Wet deposition of both NO_3^- and SO_4^{2-} at the Snowy Range station is elevated. Wet NO_3^- deposition ranged from 3 to 14 kg/ha-yr, and wet SO_4^{2-} deposition ranged from 3 to 10 kg/ha-year (Figure 3-28).

Wet deposition of NH_4^+ is low (below 2 kg/ha-yr), SO_4^{2-} is below 7 kg/ha-yr, and NO_3^- is below 9 kg/ha-yr at Brooklyn Lakes (Figure 3-29). Deposition values from 1992 through 2005 were steady, indicating that deposition did not worsen or improve during that time.

Dry Deposition

Dry deposition refers to the transfer of airborne gaseous and particulate material from the atmosphere to the Earth's surface. CASTNet measures dry deposition of SO_2 , HNO_3 , SO_4^{2-} , NO_3^- , and NH_4^+ . Figures 3-30 and 3-31 show mean annual dry deposition of sulfur- and nitrogen-containing compounds for Centennial since 1989 (Figure 3-30) and for Rocky Mountain National Park from 1995 (Figure 3-31).

Dry deposition values in Centennial have been low and steady for all pollutants except HNO_3 . Dry HNO_3 deposition ranged from 1.9 to about 3.7 kg/ha-yr. Dry deposition for other pollutants was less than 1 kg/ha-yr.

Dry deposition values in Rocky Mountain National Park were also low and steady for all pollutants except HNO_3 . Dry HNO_3 deposition ranged from 1.5 to 4.7 kg/ha-yr. Dry deposition for other pollutants was less than 1 kg/ha-yr.

Total Deposition

Total deposition refers to the sum of airborne material transferred to the Earth's surface by both wet and dry deposition. Total deposition guidelines have been estimated for several areas, including the Bridger Wilderness in Wyoming (Fox et al. 1989). Estimated total deposition LOC include the "red line" (the total deposition that the area can tolerate) and the "green line" (the acceptable level of total deposition). Total nitrogen depositions LOC for Bridger include the red line (set at 10 kg/ha-yr) and the green line (set at 3–5 kg/ha-yr). Total sulfur depositions LOC for Bridger include the red line (5 kg/ha-year) and the green line (20 kg/ka-yr). The U.S. Forest Service (USFS) has proposed a LOC for total nitrogen deposition of 1.5 kg/ha-year (Baron 2006).

Figures 3-32 and 3-33 compare total deposition in the Snowy Range near Centennial, Wyoming, with the total deposition LOC proposed for the Bridger Wilderness. Total nitrogen deposition is about equal to the existing LOC since 1992, although the measured nitrogen deposition has exceeded the proposed LOC since 1993 (Figure 3-32). Total sulfur deposition has been well below LOC for the same period (Figure 3-33).

Summary of Existing Air Quality

Air quality monitoring data provided by the State of Wyoming show that air quality in the Rawlins region is considered to be in compliance with state and federal ambient air quality standards (Table 3-2). Monitored total nitrogen deposition is within the Fox green line LOC, but above the USFS-proposed nitrogen LOC.

Table 3-2. Summary of Air Quality in the Vicinity of the RMPPA

Air Quality Component	Comment
Air Pollutant Concentrations	
Criteria Air Pollutants	Concentrations are in compliance with NAAQS and WAAQS.
Nitrogen Compounds	<ul style="list-style-type: none"> • Nitric acid (HNO₃) concentrations in Centennial and Rocky Mountain National Park are slightly higher than concentrations in other remote areas. • Ammonium (NH₄) concentrations are consistent with other remote areas. • Nitrate (NO₃) concentrations in Centennial are consistent with other remote areas, while concentrations in Rocky Mountain are slightly higher than concentrations in other remote areas.
Sulfur Compounds	<ul style="list-style-type: none"> • Sulfur dioxide (SO₂) and sulfate (SO₄⁻²) concentrations in Centennial and Rocky Mountain National Park are consistent with concentrations in remote areas.
Visibility	
Visual Range	<p>Rocky Mountain National Park</p> <ul style="list-style-type: none"> • 20 percent cleanest: 154–187 miles • Average: 100–114 miles • 20 percent haziest: 50–73 miles <p>Bridger Wilderness</p> <ul style="list-style-type: none"> • 20 percent cleanest: 160–190 miles • Average: 114–135 miles • 20 percent haziest: 72–94 miles
Atmospheric Deposition	
Precipitation pH	<ul style="list-style-type: none"> • Precipitation pH was above 4.8 from 1989 through 2004.
Total Deposition	<ul style="list-style-type: none"> • Total nitrogen deposition is consistent with the existing LOC; however, it exceeds the USFS-proposed LOC. • Sulfur deposition is well below LOC.

¹ Total nitrogen deposition LOC range from 3 to 5 kg/ha-yr (Fox et al. 1989). The USFS-proposed total nitrogen deposition LOC is 1.5 kg/ha-yr (Baron 2006).

² Proposed acceptable sulfur deposition is 5 kg/ha-yr (Fox et al. 1989).

3.3 CULTURAL RESOURCES

3.3.1 Introduction

Archeological investigations in the RMPPA indicate that prehistoric people have inhabited the area for at least 12,000 years, from Paleoindian occupation to the present. Although prehistoric sites represent the largest percentage of cultural resource sites within the RMPPA, historic-age sites including expansion-era trails, freight roads, and stage stations are quite common throughout the area.

As of December 2005, approximately 15,643 cultural resource sites had been documented. These sites include prehistoric and protohistoric archeological sites, historic sites, linear historic sites, and properties that are sacred to Native American cultures (e.g., Traditional Cultural Properties [TCP]). The majority of cultural resource sites have been documented during compliance-related activities resulting from federal management actions. The largest number of federal management actions within the Rawlins RMPPA has been related to oil and gas development, which is centered in the western portion of the RMPPA. This has resulted in an increased knowledge of cultural resources, particularly those located in the western portion of the RMPPA.

The entire RMPPA is within the larger Northwestern Plains cultural area (Frison 1991). Prehistoric sites throughout the RMPPA exhibit numerous similarities with respect to artifact assemblages, feature types, and function but can also exhibit differences based on ecological setting and cultural influences from surrounding regions. The RMPPA has been further broken down geographically into 14 subregions. These subregions are identified by geographic features and allow for a better understanding of how prehistoric inhabitants used the greater region. Table 3-3 identifies the subregions, the number of sites located within each subregion, and overall site density.

Table 3-3. Summary of Cultural Subregions

Subregion	Total Acres	BLM Acres	BLM %	Total Number of Sites	Prehistoric Sites	Historic Sites	Sites Per Acre
Great Divide Basin	1,008,105	706,925	65.0%	3,012	2,807	393	1/37
Washakie Basin	812,122	667,673	82.2%	3,991	3,793	407	1/17
Separation Flats/ Rawlins Peak	510,934	293,393	57.4%	1,197 (940)	656	367	1/29
Sierra Madre Uplands	954,124	470,744	49.3%	1,319	992	427	1/70
Hanna Basin	580,815	250,096	43.1%	1,171	1,033	206	1/53
Upper North Platte	592,277	199,313	33.7%	431	295	150	1/27
Shirley Basin	561,817	199,705	35.5%	148	132	23	1/47
Middle Medicine Bow	469,287	88,207	18.8%	591	424	199	1/50
Laramie Basin	853,260	77,459	9.1%	333	113	231	1/17
Sweetwater Arch	661,008	395,093	59.8%	166	147	33	1/77
Laramie Mountains	994,354	114,778	11.5%	371	204	180	1/23
Eastern Plains	1,558,698	1,576	0.1%	2,781	376	2,427	1/14
Bates Hole	48,160	29,480	61.2%	12	10	4	1/10
Medicine Bow Mountains	374,132	74,624	19.9%	120	48	74	1/61

Site densities may be skewed due to the presence of historic period buildings in urban settings. For example, the Eastern Plains region has one of the lowest site densities in the RMPPA. However, the majority of sites in this area are historic buildings in Cheyenne. Therefore, the site densities reflected in the column “Sites Per Acre” do not accurately represent total site densities. The columns “Prehistoric Sites” and “Historic Sites” are not additive to correlate with the total number of sites for each subregion, as numerous sites are recorded with prehistoric and historic components.

3.3.2 Prehistoric Sites

Prehistoric sites in the RMPPA are known to date from approximately 12,000 years before present (B.P.) to the time of European contact (roughly 1650 A.D.). Native American sites dating after 1650 A.D. are often assigned to the protohistoric period, in which material culture consists of traditional Native American artifacts and European trade goods. Site types in the RMPPA include lithic scatters, lithic material quarries, open camps, stone circles, rock shelters, house pits, rock cairns and alignments, game drive lines and kill sites, brush or pole structures, rock art, and human burials.

Most significant cultural resources are found along major ephemeral drainages and along the lower benches of escarpments found commonly throughout the western half of the RMPPA. Certain topographic settings have higher archeological sensitivity, such as aeolian deposits (sand dunes, sand shadows, and sand sheets), alluvial deposits along major drainages, and colluvial deposits along lower slopes of ridges.

Prehistoric sites represent a wide range of human activities. Many of the sites are surface manifestations of hunter-gatherer campsites representing repeated, inseparable occupations over hundreds or thousands of years. Other sites are buried and contain intact, vertically separated cultural components. The most common site types are short-term occupation sites with limited activity loci. At these locations, stone tools were made or repaired, plant resources were processed, or animals were killed or butchered. These site types were common throughout prehistory and are found across the RMPPA. The most common type of short-term occupation sites is a lithic scatter containing flaked stone tools and debitage (waste flakes and debris) but little evidence of subsistence strategies.

Open camps contain evidence of a broad range of activities, including subsistence-related activities. Cultural remains at these site types include formal features, lithic debris, chipped stone tools, and evidence of milling/vegetable processing activities. Remains from animal butchering activities, including bones and lithic tool types, also are often found at open campsites. Open campsites often show evidence that they were occupied for longer periods of time or were used repeatedly.

Lithic procurement areas are quite common in the RMPPA. These are manifested as lithic scatters resulting from testing, procurement, and reduction of toolstone at their sources. Source stones are primarily cherts and quartzites, occurring in either secondary gravel and cobble deposits or in primary bedrock exposures. Secondary lithic procurement sites are the most common in the RMPPA. They often occur diffusely over large areas as lithic “landscapes.” Major sources of high-quality Green River Formation cherts occur in portions of the Washakie Basin, which makes lithic procurement sites common in the area (Michaelsen 1983; Miller 1991).

Stone circle sites are in most instances another type of campsite. Also known as “tipi rings,” stone circles are widely believed to be the result of rock placement along the bases of tipis or other similar habitation structures. The possibility that at least some stone rings are the result of ritualistic/spiritual functions rather than habitation activities has also been proposed (Davis 1983). These site types are relatively common on ridge tops, upper stream terraces and benches, and mountain foothills in the North Platte River region and the Eastern Plains. They are considerably rarer in the western basins. Lithic debris and formal tools (e.g., flaked stone artifacts) are often found in conjunction with stone circles, although usually in low densities. Other types of rock features, such as cairns and alignments, may be present as well. These sites are often found to be sacred to Native American groups and may be designated as TCPs.

House pits, although still relatively uncommon, are increasingly being recognized and documented in portions of the RMPPA. Recent analyses suggest that many of these structures were occupied for short periods in more than one season and were repeatedly used over a number of years (Smith 2003). Archeological remains usually include a large circular area of charcoal-stained sediment that upon excavation reveals a generally shallow, basin-shaped living floor containing internal features, including hearths and storage pits. There is generally a paucity of artifacts within the house pits, although flaked stone, groundstone, and bone have been recovered. House pits have been found in the intermontane basins of the western and central portions of the RMPPA, with a particularly large sample identified and investigated in the Bairoil oil fields in the northeastern Great Divide Basin (Reust et al. 1993).

Less common site types in the RMPPA include rock shelters, rock art, mass kill sites, brush and pole structures (i.e., wickiups or “war lodges”), burials, and certain types of rock features such as medicine wheels, drive lines, or cairn lines. These less common site types are often found to be sacred to Native American groups and are designated as TCPs.

Paleoindian Period

The oldest period for which there is archeological evidence is the Paleoindian, beginning approximately 12,000 years B.P. and ending around 8500 B.P. This is the transition period from the periglacial conditions of the Wisconsin ice advance during the terminal Pleistocene to the warmer and drier climatic conditions of the Holocene. A savanna-like environment with higher precipitation than occurs today was prevalent in southwest Wyoming. Understanding paleoenvironmental conditions operating at the end of the Pleistocene and into the Holocene provides insights into the articulation between human populations and the environment (Thompson and Pastor 1995).

The archeological record indicates that a highly nomadic, hunting lifeway persisted throughout the Paleoindian period. Primary subsistence strategies appear to have focused on the procurement of large animals, with increasing dependence on small mammal and wild plant foods toward the end of the Pleistocene (Creasman et al. 1982).

The practical difficulty of locating and identifying Paleoindian sites, which tend to be deeply buried, is compounded by the small number of sites likely to be preserved through time. A current compilation of radiocarbon dates from archeological sites in Wyoming indicates that less than three percent of excavated sites contain datable Paleoindian components. Because of this small and unrepresentative sample, very little is known at this time of Paleoindian culture dynamics, subsistence strategies, and demography in the RMPPA.

Radiocarbon-dated Paleoindian sites or components within the RMPPA include the Union Pacific Mammoth site (Frison 1978, 1991), the James Allen site (Mulloy 1959), the Rattlesnake Pass site (Smith and McNees 1990), the China Wall site (Waitkus and Wimer 2002), and the Pine Bluffs site (Frison 1991). A few other sites reportedly have yielded early dates; however, data on these are limited. Isolated surface finds of Paleoindian projectile points are not uncommon in the RMPPA and suggest that site preservation may be a major factor affecting the number of known sites.

Archaic Period

The Archaic period dates from approximately 7,500 to 1,500 years B.P. and is split into Early, Middle, and Late Archaic periods based on Frison’s chronology (Frison 1978, 1991) for the Northwestern Plains. The term “Archaic” refers to both a temporal segment in the prehistoric record and a particular lifeway. The demise of the Paleoindian big game hunting cultures, resulting from the extinction of the late Pleistocene megafauna by approximately 7,000 B.P., marks the onset of the Archaic period. The environmental change at the end of the Paleoindian period led to a pattern of broad spectrum resource exploitation, reflected in the subsistence and settlement practices of the Archaic period, which became more diverse over time.

Archaic period sites generally exhibit more diverse assemblages of cultural remains, indicating a broader range of subsistence practices compared to the big game hunting focus of the preceding Paleoindian period. Archaic period subsistence involved the exploitation of both plant and animal resources to a greater extent than the Paleoindian period, and hunting involved a greater variety of animal species.

Slab-lined plant processing pits, characteristic of Early Archaic occupations, progressively decrease in frequency in the archeological record during the Middle Archaic period. A decrease in the overall frequency of groundstone artifacts is also noted. These trends have been interpreted by Creasman et al. (1983: 160–161) as indicating a balanced hunting and gathering subsistence strategy, with less emphasis on small mammal and wild plant foods.

Settlement and subsistence patterns for the Late Archaic in the RMPPA are poorly understood. The mixed hunting/plant-gathering orientation that characterized the preceding period seems to continue into the Late Archaic, although perhaps more emphasis was placed on big game hunting during the last 500 years of this period (2000–1500 B.P.). The paleoenvironmental record for the area suggests gradual cooling, with conditions, on average, not much different from today.

Numerous sites have been dated to the Archaic period in the RMPPA, particularly the Middle and Late Archaic periods. Important sites include the Seminole Beach site (Frison 1991), the Scoggin site (Lobdell 1973), the Muddy Creek site (Hughes 1981), the Mill Creek Bison Jump, and Sorenson Shelter. The China Wall and Pine Bluffs sites also contained Archaic components. Archaic sites containing house pits include the Medicine House site (Miller and McGuire 1997), the Shoreline site (Walker et al. 1997), the Sinclair site (Smith and Reust 1992), and several sites at Bairoil, most notably the Bald Knob site (Reust et al. 1993).

Late Prehistoric Period

The Late Prehistoric period began approximately 1,500 years B.P. and continued until European contact at around 1650 A.D. The beginning of this period is marked by the introduction of the bow and arrow and, consequently, an overall reduction in projectile point sizes. Pottery begins to appear (although rarely) in Late Prehistoric assemblages, and stone circles become an increasingly common element of sites, particularly east of the Wyoming Basin. House pits are less common than in earlier periods, although they have been identified.

An increase in aboriginal populations apparently began toward the end of the Archaic period and continued through the first half of the Late Prehistoric period (Frison 1991). Consequently, there is a dramatic increase in sites radiometrically dated (as well as cross-dated through diagnostic artifacts) to this period. A large percentage of excavated sites in the RMPPA either date to the Late Prehistoric period or at least have a Late Prehistoric period component overlying older components.

Aside from the overall increase in site frequency, Late Prehistoric settlement and subsistence patterns do not appear to have diverged markedly from those of the Late Archaic (Creasman et al. 1983: 161). Large mammal resources, including antelope and bison, were of primary importance, while plant foods continued as a significant dietary element. Ash-filled basins and cobble-filled hearths are dominant feature types.

Protohistoric Period

The Protohistoric period began at first contact between Native Americans and Euro-Americans around 1650 A.D. in the RMPPA. Ever-increasing contact led to the introduction of the horse to Native Americans and the appearance of trade goods such as beads and metal items in the archeological record.

The adoption and use of horses significantly increased the mobility of Native Americans in the area. Groups that acquired horses early gained a decided advantage over groups that did not.

Historic Period

The historic era began in earnest by the early 1800s, with the arrival of well-organized fur trading expeditions in the region. Major themes represented by historic cultural resources in the RMPPA include ranching, transportation, and mining.

Historic sites in the RMPPA include emigrant trails; stage and freight roads; stage stations; railroads and sidings; early automobile roads; ranches and ranching-related features; cabins, buildings, and other structures; towns and camps; dams and irrigation ditches; stockherder camps and trash scatters; trash dumps; mines and mining facilities and debris; and oil and gas facilities.

Ranching

Although pioneering efforts were started in western Wyoming, the focus of the cattle industry was on southeastern Wyoming. In 1862, the Homestead Act enabled ranchers to obtain 160 acres of free land; additional acreage could be acquired under the Timber Culture Act of 1873 (160 acres), Preemption Act of 1841 (160 acres at \$1.25 per acre), and Desert Land Act of 1877 (640 acres at \$1.25 per acre). Ranchers usually patented land along a waterway to use as a base of operation while grazing their cattle on surrounding public domain.

In the 1870s and 1880s, foreign capital was invested in the Wyoming cattle industry and syndicate ranches began. British and Scottish interests invested \$45 million in the American cattle business, much of it in the Wyoming territory.

Competition and an increase in cattle diseases led to the erection of barbed-wire fences in Wyoming. The continually growing cattle herds rapidly overstocked the range in terms of grasses and available water, and the hard winters of 1884–1887 caused tremendous losses of cattle. The open range system collapsed as the large companies withdrew and paved the way for small ranchers.

Wyoming's Red Desert became a traditional winter range for sheep, where flocks arriving from the west in run-down condition regained their vigor before moving to higher summer pastures. Sheep adapted to semi-desert country better than cattle because of their ability to go longer without water. Sheep could obtain moisture by eating snow and could exist for a long time on dew collected on desert vegetation (Wentworth 1948). Cattle empires had existed for at least 10 years prior to the advent of sheep ranching in Wyoming (Vass and Pearson 1927), securing prime areas of grass and water. The one exception was the vacant Red Desert; sheepmen quickly filled this void and remained there throughout Wyoming's history (Wentworth 1948).

By 1880, nearly all of the early sheep operations were located along the Union Pacific tracks for shipping purposes (Rollins 1951; Wentworth 1948). Forty thousand head of sheep were shipped out of Wyoming that year. With the decline of the cattle industry after the devastating blizzard of 1886, the sheep industry made significant gains, and by 1900 there were 3.3 million head of sheep in Wyoming (Wentworth 1948). The biggest jump in the number of sheep raised in Wyoming started in 1897 when the market value of sheep increased. By 1901, the price of sheep had doubled. Numbers reached an all-time high of 7 million in 1910. Wyoming retained its position as one of the chief sheep producers in the country, and 25 percent of the state's sheep were raised in the Red Desert region (Ankeny 1956).

Today, evidence of both cattle and sheep ranching in the RMPPA can be found through homesteads, ranches, sheepherder camps, and sheepherder cairns (sometimes used to demarcate grazing boundaries).

Transportation Routes

Transportation routes (i.e., trails, roads, and railroads) command a great amount of management attention because of their overall historic importance in western settlement and expansion and their presence over long distances within the RMPPA. Some of these properties are encountered on a frequent basis during

cultural resource inventories. The general locations of selected National Register of Historic Places (NRHP)-eligible linear properties across the RMPPA are shown on Map 2-46.

The affected environment of historic trails—including the Overland Trail, Cherokee Trail, Rawlins to Baggs Freight Road, and Rawlins to Fort Washakie Freight Road—is discussed in the historic trails section of the document (3.13.2.2).

Union Pacific Railroad

U.S. Government surveys conducted for the transcontinental railroad in 1865 and 1866 located 10 possible routes for crossing the north/south-trending Continental Divide within a 300-mile area between South Pass to the north and Pikes Peak to the south; most were impractical due to high elevations and rough mountain terrain. Chief Engineer General Grenville Dodge recognized the South Pass emigrant route to the north as the best from an engineering perspective, but the southern route had abundant coal deposits, and it was 40 miles shorter and closer to Denver. The Lodgepole Creek route north of Cheyenne and the Cache la Poudre River route were deemed the most satisfactory for crossing the Divide until, in 1866, General Dodge located the final route west over the Laramie Range via Lodgepole Creek, Crow Creek, and a natural ridge or gangplank that ascended gently to the summit. This route was shorter and possessed less gradient per mile for construction to reach the summit at Evans Pass (renamed “Sherman Pass”). The deep ravine at Dale Creek was an obstacle that required the construction of one of the largest timber trestle bridges ever built; it was replaced with a steel bridge in 1876 (U.S. Congress, Senate 1866: 18–24; Beard 1933: 170; Larson 1978: 38–39; Homsher 1965: 18–20, 22).

Stansbury and Bryan had determined the practicality of an overland route around Elk Mountain in the 1850s, and the discovery of coal deposits dictated the route of the Union Pacific (UP) through southern Wyoming west of the Laramie Range. Geologist David Van Lennep discovered the initial coal deposit near the future Carbon town site in 1867 (Klein 1987: 116), and Ferdinand V. Hayden’s scientific exploration in 1868 located, surveyed, and recorded the prominent coal outcrops in the Carbon Basin, the Medicine Bow River Valley, and west across southern Wyoming. This exploration finalized the route for the UP portion of the transcontinental railroad already pushing west from Laramie in the spring of 1868 (Hayden 1873: 95; Dobbin et al. 1929: 3–4). Placement of the main line depended on the utilization of coal resources located in a region devoid of timber (U.S. Congress, Senate 1886: 86, 179; Larson 1978: 39). The first coal mining operation in Wyoming Territory was at Carbon, and the problem of a dependable fuel supply was alleviated by further coal discoveries at Rock Springs and Almy (Union Pacific Coal Company 1940: 18, 27).

Construction of the UP and commercial coal development in the Carbon Basin began simultaneously. The town of Carbon, with its associated mines, sprang up overnight in 1868 and provided employment to those who came west. Homesteads were squatted and freighting continued along the Overland Trail for another decade, connecting the small communities along the trail and outlying ranches with the UP railheads to the north.

UP Railroad Construction Within the RFO RMPPA

The UP was constructed through southern Wyoming Territory during 1867 and 1868. Cheyenne was established as an end-of-track town in July 1867 and remained so for 6 months, with Fort D.A. Russell providing protection and an element of law and order. Laramie City was established in May 1868 as the headquarters for construction throughout the year, with Fort Sanders (1866) offering protection. Benton was established in July 3 miles west of Fort Steele (1868), but it lasted only a few months before it was abandoned in late October/early November 1868. The UP was constructed to Evanston in December 1868, and the transcontinental line was completed at Promontory Summit, UT, on May 10, 1869 (Beard 1933: 169–179; Pence and Homsher 1956: 53–57; Homsher 1965; Larson 1978: 41–59, 62).

The original UP Railroad (RR) grade was abandoned in 1901, the tracks and ties were removed, and the railroad was realigned and rebuilt. Much of the original grade has been impacted by pipelines, roads, and

other developments over time (as well as by the Lincoln Highway and the modern UPRR), but portions of the original grade still remain and have been recorded in the RMPPA.

The Lincoln Highway

The origin of the modern highway system in Wyoming can be traced to the Session Laws of 1911, the creation of the voluntary Wyoming Highways Association in 1912, and the national coast-to-coast Lincoln Highway that was proposed in 1912–1913. Legislation passed in 1911 proposed several highway routes that constituted the first system of state highways in Wyoming; these routes were designed to systematically connect the vast interior regions of the state. Listed as the first of seven proposed highways described in the Session Laws was a route to Yellowstone National Park from Cheyenne to Cody (Wyoming State Legislature 1911: 58–59).

The Lincoln and Yellowstone Highways traversed diverse geographical regions of Wyoming and fostered increased visitation to Wyoming. As a result, Yellowstone Park was opened to automobile traffic in 1915. Both the state highway department and state highway commission were established in 1917 and authorized to accept federal aid for road construction on a matching basis. Funding for Wyoming highway construction was augmented in 1920 with the passage of the Oil and Gas Leasing Act, which paid royalties to the state producing the oil and gas to be used for highway construction (Beard 1933: 602–603, 626–628; Larson 1978: 407, 423–425, 431).

The route chosen in 1913 followed the basic course laid down by travelers on the Overland Trail and later the UP railroad grade. Between 1919 and 1924, Wyoming completed its portion of the Lincoln Highway, which realigned the 1913 route in many places. As of 1924, the most topographically direct route across the state totaled 427 miles from Pine Bluffs west to Evanston and beyond to the Utah border. Instead of using the Lincoln Highway Association’s engineering standards, Wyoming chose a design that met the demands of the day and of the state’s budget. Within the right of way, the graded surface measured 24 feet wide, in the center of which was 16 feet of gravel, 5 inches thick. Drainage structures were of corrugated metal or reinforced concrete. All bridges were constructed of reinforced concrete.

From its inception, the Lincoln Highway from Pine Bluffs to Laramie was “good gravel” except the portion between Buford and the Summit that was “graded gravel.” Between 1919 and 1920, the Wyoming Highway Department completed an entirely new road between Cheyenne and Laramie eliminating many difficult grades. The road was surfaced with Sherman gravel. Between Laramie and Medicine Bow, the highway followed the road previously in existence; it was maintained in good repair (Lincoln Highway Association 1924: 409–416).

Wyoming completed a new road of “graded gravel” from Medicine Bow west to Rawlins during the early 1920s; an 80-foot bridge was built over the Medicine Bow River. At this time, there was criticism by those who felt that the Lincoln Highway should pass through their respective towns or cities. In Wyoming, a bitter struggle over the proposed route between Laramie and Rawlins was resolved only when Governor Joseph M. Carey (1911–1915) issued a formal proclamation establishing the route as laid out by the Association (Lincoln Highway Association 1935: 158; Beard 1933: 569).

Between 1920 and 1924, the state highway department reconstructed the road between Rawlins and Wamsutter. The state appropriated the abandoned UP rail bed constructed of Sherman gravel. Bridges were built and the rail bed was scraped down to provide additional width and crowned for highway traffic (Larson 1978: 407; Lincoln Highway Association 1935: 238; 1924: 417–19). The road was reconstructed between Wamsutter and Red Desert Station in 1920 following the existing road. From Red Desert Station to Thayer Junction, the road was entirely relocated and reconstructed, including the addition of three concrete bridges over 20 feet in length. From Thayer Junction to Rock Springs another new alignment was constructed on the north side of the UP line, eliminating two grade crossings of the main line (Lincoln Highway Association 1924: 421–24).

Portions of the highway were upgraded, rebuilt, and realigned in each succeeding decade up through the 1940s culminating in the construction of U.S. Highway 30. Remnants of the various grades are frequently encountered in the RMPPA, although many have been altered or destroyed by Interstate 80 (I-80) and U.S. Highway 30.

3.3.3 Native American Cultural Resources

Cultural resources that are considered sensitive and potentially sacred to modern Native American tribes include burials, rock art, rock features and alignments (such as cairns, medicine wheels, and stone circles), Indian trails, and certain religiously significant natural landscapes and features. Some of these resources may be formally designated as TCPs or Indian Sacred Sites. A TCP is a site considered eligible for inclusion on the NRHP because of its association with cultural practices or beliefs of a living community that are (a) rooted in that community's history and (b) important in maintaining the continuing cultural identity of the community.

Indian Sacred Sites, as defined in Executive Order (EO) 13007, are "any specific, discrete, narrowly delineated location on federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion." Indian Sacred Sites are not always eligible for the NRHP; however, pursuant to the guidelines in EO 13007, they receive the same protective measures as NRHP-eligible historic properties.

A cultural resource site is designated as a TCP or Indian Sacred Site only after consultation with tribal representatives has occurred (Appendix 5). While archeologists may identify sites or specific site types as potential TCPs or Indian Sacred Sites, identification and designation of such sites relies heavily on information from tribal representatives. Likewise, one tribe may view a locality as a TCP or Indian Sacred Site while another may not, depending on the cultural practices or beliefs of individual tribes.

3.3.4 Cultural Resource Management Use Allocations

As mandated in BLM Manual 8130, all cultural resources in the RMPPA 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 prehistoric age cultural resources in the RMPPA are allocated to category (a), Scientific Use, as this pertains to most historic and prehistoric archeological resources that are evaluated for nomination to the NRHP under 36 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.

Archeological resources allocated to category (f), Discharged from Management, are those sites which have no remaining identifiable use. Properties discharged from management remain in the inventory, but they are removed from further management attention and do not constrain other land uses. Particular classes of unrecorded cultural properties may be named and described in advance as dischargeable upon documentation, but specific cultural properties must be inspected in the field and recorded before they may be discharged from management.

Cultural resources in category (b), Conservation for Future Use, include significant properties that are deemed worthy of segregation from all other land or resource uses, including cultural resource uses, that would threaten the maintenance of present conditions or setting as pertinent. Properties assigned to this category will remain in this use category until specified provisions are met in the future. One property in the RMPPA, the Aimee Eaton Buffalo Kill Site, is allocated to this use category. Pursuant to a memorandum of agreement (MOA) between the Wyoming State Historic Preservation Officer and BLM, RFO, the site will remain under the jurisdiction of BLM until adequate mitigation measures have been carried out. In addition, annual monitoring of the site will occur to determine whether any natural erosional processes have adversely impacted the site.

Cultural resources in category (c), Traditional Use, include those properties that are important to the identity, heritage, or well-being of specific social and/or cultural groups. In the RMPPA, this use category pertains primarily to Native American sensitive sites and TCPs.

Category (d), Public Use, includes cultural properties appropriate for interpretative, educational, or recreational uses by the general public. In the RMPPA, these would include the Overland Trail and other select historic emigrant trails and associated properties. The JO Ranch, a private historic ranch complex that is currently part of an ongoing exchange proposal, would be developed for public use once the exchange is complete and the JO Ranch becomes public land.

Category (e), Experimental Use, would include 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. There are no cultural properties currently allocated to this use category in the RMPPA.

3.4 WILDLAND FIRE AND FUELS

Firefighter and public safety is the first priority in the wildland fire and fuels management program. Wildland fires in the RMPPA occur as the result of an act of nature, such as lightning, or are caused by humans either accidentally or with the intent to cause damage. Prescribed fire is used for beneficial purposes (such as reducing hazardous fuel accumulation) in a controlled manner under a specific prescription and planned effort. Wildland fires resulting from an act of nature can sometimes be managed to achieve resource objectives.

The response to a wildland fire is based on an evaluation of risks to firefighter and public safety; the circumstances under which the fire has occurred, including weather and fuel conditions; natural and cultural resource management objectives; protection priorities; and values to be protected. Wildland fire can be used to protect, maintain, and enhance resources and, as nearly as possible, can be allowed to function in its natural ecological role. The evaluation must also include an analysis of the context of the specific fire within the overall local, geographic area, or national wildland fire situation. The full range of fire management activities will be used to help achieve ecosystem stability, including its interrelated ecological, economic, and social components.

3.4.1 Wildland Fire Occurrence and Ignition Sources

Lightning is the primary natural cause of wildland fire in the RMPPA. Natural ignitions occur throughout the RMPPA, although some areas, such as the Seminoe Mountains and Laramie Range, have higher wildland fire frequencies from lightning ignitions. Human-caused fires in the RMPPA have also been widespread. The majority of human-caused fires have occurred along the I-80 and railroad corridors, primarily in sagebrush and grassland communities. Historically, wildland fires have also occurred in camping and woodcutting areas by accidental ignition caused by fireworks, outdoor recreation fires, and

machinery. Fireworks and railroad-associated fires account for the majority of human-caused ignitions in the RMPPA.

3.4.2 Fuels Management

Vegetation treatments are used in the Rawlins RMPPA to control the buildup of fuels and to meet the needs of other resources (including rejuvenating areas where vegetation has become decadent and setting back local succession so that diverse patches of habitat are present). Areas dominated by cheatgrass or other invasive species are examined case by case during planning of prescribed burns. For more complete discussion of prescribed fire and mechanical, chemical, and biological treatments, see Appendix 19.

3.4.3 Use of Wildland Fire

The use of wildland fire for resource benefit reduces fuel loading and the amount of effort needed to control large fires, and allows wildland fire to function in its natural ecological role where possible. Map 2-1 designates areas where the use of wildland fire for resource benefit is most likely to occur. Opportunities to use wildland fire in the checkerboard and mixed land ownership areas are limited but would be pursued when wildland fire would not endanger private property.

3.4.4 Wildland Urban Interface

Approximately 215,000 acres have been identified in the Rawlins RMPPA as having Wildland Urban Interface (WUI) characteristics (Map 2-1). WUIs are defined as communities in which humans and their development meet or intermix with wildland fuel, where there is a high probability of wildland fire occurrence. These areas contain large numbers of dispersed ranches and first and second homes. Sixty-one at-risk communities are located in the RMPPA (Map 2-1). WUIs and other at-risk communities receive priority for hazardous fuel reduction treatments. In addition, industrial developments located in the RMPPA that are at risk from wildland fire also receive priority for fuel reduction treatments.

3.4.5 Community Assistance

Community assistance in the Rawlins RMPPA consists of cooperative agreements, training, rural assistance, and monetary grants. There are currently six cooperative agreements concerning suppression of wildland fires. Wildland fire training is coordinated with cooperators to meet their training needs. Rural assistance and monetary grants have averaged between \$80,000 and \$110,000 annually. These grants are designed to improve the training and equipment of cooperating fire departments for firefighter and public safety.

3.4.6 The Role of Wildland Fire in Plant Communities of the RMPPA

Fire frequency and severity vary by plant community, and extensive suppression has altered natural fire cycles in some areas. In some plant communities in the RMPPA, this accumulation has changed the structure and composition of the vegetation community (i.e., resulted in the reduction of the natural variation of vegetative communities) and could result in undesirable fire behavior and fire effects. Drought also affects fire behavior and fire effects in many ways, such as by reducing the amount of fine fuels and reducing fuel moisture content.

Using the ecological provinces described in the vegetation section, the Intermountain Semi-Desert Province of shrublands, with pockets of aspen, limber pine, and juniper, historically would have experienced fire frequencies of 35–100-plus years, resulting in a mixed severity of effects on the vegetation (Fire Regime III). The Great Plains Dry Steppe Province of mixed and short grass prairies would have experienced a fire frequency of 0–35 years, with stand replacement effects (Fire Regime II). The Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest Province consists of mixed

shrub communities, forests of pine and spruce in seven mountain ranges in the RMPPA, and alpine tundra. Depending on the species, shrub communities would have experienced fire frequencies of 0–35 years with stand replacement severity (Fire Regime II) or frequencies of 35–100-plus years with mixed severity (Fire Regime III). The pine forests likely experienced fire frequencies of 35–100-plus years with either mixed severities (Fire Regime III) or stand replacement severity (Fire Regime IV). Spruce forests and alpine tundra areas with patches of spruce and fir trees burned with a 200-plus-year frequency with stand replacement severity (Fire Regime V).

As noted above, unnatural fuel loading in forest stands and other vegetative types would be reduced through prescribed fire and mechanical, chemical, or biological treatments for the purpose of restoring ecological conditions or other desired vegetative conditions. Most prescribed burns in sagebrush and mountain shrub communities will occur in areas where the percentage cover of shrubs exceeds 30 percent. To achieve objectives for prescribed fire in aspen stands in the RMPPA, the stand should have less than 40 percent canopy cover of aspen and at least 15 percent cover of sagebrush, or have 40 percent to 60 percent conifer cover in the stand.

3.4.7 Emergency Stabilization and Rehabilitation

Fires will be evaluated as to whether emergency stabilization (actions to stabilize and prevent unacceptable degradation to natural and cultural resources, minimize threats to life or property from the effects of fire, or repair/replace/construct physical improvements) is necessary to prevent degradation of land or resources. The need for rehabilitation (efforts to repair or improve lands unlikely to recover to a management-approved condition from wildland fire damage, or to repair or replace minor facilities damaged by fire), including planting trees to reestablish burned habitat, reestablishing native tree species lost in fire, repairing damage to minor facilities (campgrounds, exhibits, fences, guzzlers, etc.), restoring habitat, treating invasive plants, maintaining roads/trails, restoring heritage sites, and replacing fences when such damage is caused by wildland fire, will also be evaluated.

3.5 FOREST MANAGEMENT

Forested areas within the RMPPA boundaries mainly are located within several mountainous areas: Shirley Mountain, located in the north-central part of the RMPPA; Elk Mountain, located in the south-central part of the RMPPA; Ferris Mountains Wilderness Study Area (WSA), located in the north-central part of the RMPPA; Seminoe Mountain; Bennett Mountain; Powder Rim; and the Laramie Peaks area. There are also a number of forested areas on the fringe of the national forest boundaries (Map 3-1). Forest acreage within the RMPPA is small compared with the RMPPA's total area. Total acreage of forested land managed by BLM within the RMPPA is 196,934, or approximately 1 percent of the total area.

The condition or health of forest stands varies by location. The general absence of large fires over the past 80 years has made forests more susceptible to disease such as dwarf mistletoe, mountain pine beetle infestations, and newly introduced diseases such as white pine blister rust, which has increased the mortality rate and the amount of dead standing timber in federal forests. In addition, species such as lodgepole pine (Appendix 28) have not experienced the natural regenerative properties of fire. Conifers are encroaching on aspen stands, limiting aspen regeneration. Along with conifer encroachment, disease and insect damage are also playing a major role in the increasing mortality rate of older mature aspen clones. There has also been a decline in timber harvesting over the past decade, allowing for additional buildup of overall biomass. The majority of commercial timber in the RMPPA is located within the Shirley Mountain and Elk Mountain areas. Descriptive summaries of the forest resources within these two areas follow.

3.5.1 Shirley Mountain Forest

The Shirley Mountains are a relatively isolated mountain range in the northern portion of Carbon County in south-central Wyoming. They are located entirely within the RMPPA and contain a mixture of BLM-managed public lands, state lands, and private land parcels. This forest encompasses approximately 22,843 acres of federal lands within the RMPPA. The Shirley Mountains provide diverse resource values and uses, such as forests, wildlife habitat, recreational opportunities, minerals, watershed, livestock grazing, communication sites, and cultural resources.

The condition of forest resources in the Shirley Mountain Forest is discussed below by forest type. Because of differences in forest management practices, the condition of BLM-managed public parcels and private parcels that have been timbered differs markedly. Diversity is low not only from the standpoint of relative acreage in the different forest types but also because of diversity within different successional stages for all these forest types. This condition is primarily due to the lack of stand-replacing disturbances over the past 80 years.

Lodgepole Pine Forest

The lodgepole pine forest type, comprising approximately 9,860 acres, is the result of past stand-replacing wildland fires, dating from the 1860s to the 1910s. This forest type is generally healthy but will decline in vigor and productivity as the forest becomes more decadent. In addition, there are insect and disease concerns that may compromise future health. Infestations of pine beetles and dwarf mistletoe are apparent. Current age class distribution is heavily unbalanced toward the mature age class, reflecting the long period since the last fires.

Spruce-Fir Forest

The major species component of the spruce-fir forest type is subalpine fir, with occasional Engelmann spruce. This forest type is found on only about 330 acres of the Shirley Mountain Forest. It is even-aged and fairly young considering the longevity of Engelmann spruce and subalpine fir. Spruce-fir exists as

small, isolated stands away from the large acreages of dense lodgepole pine and has the same date of origin as its neighboring stands. Old, remnant lodgepole pine trees are not found in the spruce-fir stands. Occurrence of the spruce-fir forest type is probably a result of less-intense wildland fire in the area and an available seed source. There is also an established understory (more than 50 trees per acre) of young subalpine fir seedlings and/or saplings on about 5,877 acres of lodgepole pine and aspen forest. These forested areas will convert to subalpine fir forests, but this process may take 100 years or more and will occur only if there are no wildland fires.

Aspen Forest

Comprising about 810 acres, the aspen forest type, like the spruce-fir type, is not well represented in the area. Aspen are found primarily on steep, rocky slopes or in low, wet areas; therefore, opportunities for management are limited. In addition, conifer invasion is occurring in most of the aspen stands, which could result in further reductions in aspen presence. Barring major surface disturbance (e.g., fire, mechanical treatment), the majority of the aspen stands will eventually be replaced by conifers. However, this conversion is not anticipated to occur within the next 20 years. Aspen is a minor component in more than one-third of the lodgepole pine stands. Removal of the conifers would promote aspen regeneration.

Woodland Forest

The majority (11,843 acres) of the forested land in the Shirley Mountains is woodland forest type. The most common tree species is limber pine. Juniper woodlands also occur. The trend in vegetative structure in this type of forest is toward increasing tree density. The existing vegetation allows seedlings to establish in previously open areas. This filling-in will increase crown cover and reduce forage for wild and domestic ungulates.

3.5.2 Elk Mountain Forest

Elk Mountain is located in the southeast quarter of Carbon County, just north of the Medicine Bow National Forest. BLM administers approximately 5,670 acres of forested land in this area.

Forest types in this area change in relation to elevation. In the subalpine zone, at 9,000 to 11,000 feet, Engelmann spruce and subalpine fir dominate. In the area below this elevation, the forest type is almost exclusively lodgepole pine. Below the lodgepole pine is an area of mixed lodgepole pine and Douglas fir. Aspen, limber pine, scattered ponderosa pine, some Douglas fir, and lodgepole pine predominantly cover the foothills of Elk Mountain. The more productive forest stands are located on areas with a north-to-northeast aspect. Stands that occur on the west and south slopes of the mountain are not as productive.

Forests on Elk Mountain are not in good condition. Past cutting practices, often in the form of high grading, along with past insect infestations and fire suppression have resulted in a deteriorating forest resource on Elk Mountain on both public and private land. Many acres have had poor natural regeneration. Dwarf mistletoe occurs on all coniferous species on Elk Mountain, with considerable damage appearing in lodgepole pine. The condition of forest resources in the Elk Mountain Forest is discussed below by forest type.

Lodgepole Pine Forest

On Elk Mountain, 1,083 acres consist of the lodgepole pine forest type. The majority of lodgepole stands have reached their recommended rotation age of 100 years; thus, growth has slowed. Some patches have severely deteriorated. Virtually all of the lodgepole stands owe their origin to fires that occurred in the 1800s. Because of extensive even-aged lodgepole pine stand growth, overcrowding occurs. Lodgepole pine is generally considered a long-lived seral species, with subalpine fir and Engelmann spruce being the eventual climax species. Situations do exist, however, in which seral species remain on site instead of

being replaced by normal climax species. In such situations, the lodgepole pine could be considered the climax tree species.

The Douglas fir forest type is generally found in association with lodgepole pine in this area, on the lower reaches of the mountain. Many of these trees are residual trees from prior stands.

Spruce-Fir Forest

Subalpine fir and Engelmann spruce are generally becoming established under much of the lodgepole pine, following forest succession into a climax forest. There are large areas where subalpine fir constitutes a major portion of the overstory. Engelmann spruce occupies a mixed conifer forest with subalpine fir, the latter being the first species to grow. Spruce stands make up approximately 2,486 acres of the Elk Mountain Forest.

Aspen Forest

Aspen occupy wet draws and drainages on Elk Mountain. Aspen stands generally provide an overstory for subalpine fir seedlings, with the probability that the stand will eventually reach a spruce-fir climax condition. Many of the aspen stands are disease-ridden and of poor quality.

Woodland Forest

Limber pine occupies the more exposed and harsh sites throughout the area. The drier south-facing slopes on Elk Mountain are often covered with widely spaced limber pine. In some locations, the limber pine appears to be invading sagebrush-covered meadows, competing successfully with the deep-rooted sagebrush. After the limber pine has been established for several decades, a desirable environment for other tree species, such as lodgepole pine, develops, and the species composition of the site changes.

3.6 LANDS AND REALTY

The RMPPA manages approximately 3.5 million acres of public land. Resources and uses of the land are diverse, ranging from oil and gas development to grazing, wildlife habitat, and recreation. The current land use environment is characterized by an increase in development by the oil and gas industry and in private and urban development. The expected increase in oil and gas production, as well as the potential for development of alternative energy sources such as wind energy, is likely to have a greater impact on land distribution and use in the near future. Changes in the ownership of surrounding private land also have an impact on the development of public lands. The most important characteristic of such ownership changes may be the resultant fragmentation and isolation of segregated parcels of public land.

Land ownership within the RMPPA is shown in Map 1-2. The most prominent land resource feature in the RMPPA is a large swath of land that is divided into a checkerboard pattern of ownership. This swath of land is approximately 40 miles wide and runs from east to west across the entire RMPPA. The checkerboard pattern, with alternating sections of private and public land, runs 20 miles to the south and 20 miles to the north of the UP railroad line. Each section in the checkerboard is 1 mile square. Ownership is divided among private land, BLM-managed public land, and state land.

Over time, little consolidation has taken place in the checkerboard area, the principal control and use of the surface being by the livestock industry. However, over the past 20 years there has been a trend of selling private lands to realtors, who then sell 40-acre tracts to willing buyers seeking to “own a piece of the West.” As this ownership and land use changes in the future, there is potential for management of the public lands to become much more complicated, with potential conflicts and increased impacts to BLM-administered portions of the checkerboard. Over the past 12 years, Carbon County has developed a land use plan and zoning regulations to guide land development for preserving values such as open space and crucial wildlife habitat, protecting private property rights, and maintaining efficient services by promoting rural expansion closer to existing communities and infrastructure. Where similar values exist, BLM management prescriptions and permitted action should facilitate the planning and zoning implemented by Carbon County. Values on adjacent public lands benefit from these policies but would be better protected while ensuring that private land values are maintained if further land surface exchanges were to occur.

Land and mineral ownership acreages and whether they are covered by RMP decisions are shown in Table 1-1. Generally, RMP decisions cover all BLM-managed federal surface lands and their underlying minerals, whether the minerals are federally or nonfederally owned, and nonfederal surface underlain by BLM-managed minerals. Federally owned mineral rights are shown in Map 1-3.

3.6.1 Land Ownership Adjustment

Under the disposal criteria of the Federal Land Policy and Management Act of 1976 (FLPMA), about 63,460 acres were identified for consideration of disposal. However, that acreage figure was reduced to 46,230 because parcels that contain legal access across them were eliminated from consideration for disposal. Lands identified for disposal under Sections 203 and 206 of FLPMA and identified as such in this plan are hereby classified for disposal under Section 7 of the Taylor Grazing Act of 1934 as amended (43 USC 315f) under EO 6910, and under 43 CFR 2400. Exchanges are subject to the procedures outlined in CFR 43, Chapter II, Part 2200, Sections 0–6.

The RFO staff considers land exchanges on a case-by-case basis, as they are proposed. All lands considered for disposal through FLPMA sale must meet one or more of the criteria outlined in Section 203(a) of FLPMA. These criteria characterize lands for potential disposal as lands that are difficult or uneconomical to manage; lands acquired for a specific purpose but no longer required for that or another federal purpose; or lands that will serve important public objectives, including but not limited to expansion of communities and economic development, that outweigh other public objectives and values.

3.6.2 Withdrawals/Classifications

Withdrawals and classifications are typically placed on land or minerals to protect resource values or existing facilities, although they can selectively prohibit some management actions that would otherwise protect additional resource values. Most of the withdrawals and classifications that have been put in place at various times have prohibited mineral and agricultural entry and disposal, but some have also prohibited nonmetalliferous mineral entry and disposal of coal, limited rather than prohibited mineral entry, or protected water sources. Withdrawals and classifications are periodically reviewed to see whether they are serving their intended purpose and may be revoked if they are not.

Current withdrawals of public land comprise approximately 935,530 acres (Table 3-4) within the RMPPA (Valentine 2002). In the past, the largest withdrawals have been made for coal, oil shale, and stock driveways, with coal representing the largest withdrawal at over 600,000 acres. Bureau of Reclamation (BOR) lands and public water reserves constitute more than 120,000 acres. The remaining acres that have been withdrawn include wildlife refuges, air navigation sites, power sites, and administrative sites.

Table 3-4. Withdrawal Summary

Type of Withdrawal	Acreage ¹
Stratton Hydrology	2,694
Administrative Sites (BLM)	93
Administrative Sites (USFS)	720
Reclamation (BOR)	73,290
Wildlife Refuges	3,915
Air Navigation Sites (Federal Aviation Administration [FAA])	440
Public Water Reserves ²	46,095
Oil Shale	564,758
Coal Withdrawals	610,170
Power Sites ³	5,150
Stock Driveways ³	263,258
Total Existing Withdrawals^{4,5}	935,530

¹ Because of land surface overlaps, acreage figures for individual areas do not add up to the total acreage value.

² The original public water reserve withdrawals included segregation against the location of nonmetalliferous minerals. Withdrawal review reports completed in 1982 revealed that this segregation is unnecessary to protect the water sources. Public Water Reserve 107 also said that all water sources existing on the date of the withdrawal order were protected and withdrawn even if they were not noted to the official records. Therefore, 4,850 acres of previously unrecorded water sources are included.

Public water reserves withdrawn under Secretarial Order 107 and other classification orders will be reviewed to determine if they meet the retention requirements of legal opinions of the Solicitor of the Department of the Interior and the agreement made between the State of Wyoming and the Department of Justice (for the Department of the Interior) concerning the adjudication of water rights. Withdrawals will be terminated on public water reserves that do not meet retention requirements.

³ These withdrawals segregate the land against operation of the public land laws but not the 1872 General Mining Law.

⁴ Except for power sites and stock driveways, these withdrawals segregate the land against operation of the public land laws and from mineral location under the 1872 General Mining Law.

⁵ These withdrawals are scheduled for future review. Recommendations from the reviews will be arrived at on a case-by-case basis. It is possible that portions of the BOR withdrawals may be

revoked, returning the lands to the jurisdiction of BLM.

3.6.3 Utility/Transportation System

Leases and rights-of-way (ROW) grants are spread throughout the RMPPA. The majority of leases and grants within the RMPPA are for oil and gas development. Wind energy rights-of-way (Map 3-2) on BLM-managed land comprise approximately 17,000 acres, with 35 turbines (as of mid-2002) on public land.

3.6.4 Transportation and Utility Right-of-Way Corridors

Existing major transportation and utility ROWs (Map 2-2) provide an adequate net (de facto corridor) for the placement and development of future ROWs. Current ROWs are sufficient to meet the priorities for interstate transmission of telephone communication, electric power, fluid mineral resources, and interstate commercial and private travel. These facilities include—

- The state and interstate highway system (I-80 and I-25), Federal Highway 287, and State Routes 789 and 230
- Major natural gas delivery systems (i.e., Sinclair pipeline system from Sinclair, Wyoming, to Billings, Montana; CIG pipeline from Greasewood, Colorado, to Wamsutter, Wyoming; Lost Creek pipeline from Crooks Gap to Wamsutter; Exxon/Frontier Pipeline in the northwest portion of the RMPPA; Pioneer/Conoco pipeline from Croydon, Utah, to Sinclair, Wyoming, along the I-80 corridor; and I-80 and I-25 highway routes utilized for major natural gas pipeline transportation routes)
- Electric transmission lines (i.e., Wyoming Area Power Administration [WAPA] electric power delivery system corridor from Seminoe Reservoir to Cheyenne; the power line located in the northwest portion of the RMPPA, from I-80 heading north-northeast to the RMPPA boundary; the Spence-Bairoil-Jim Bridger 230 kV transmission line; and the electric transmission line running northeast from Cheyenne, Wyoming, to Nebraska).

These corridors, with the exception of the WAPA line, Federal Highway 287, and State Route 789, satisfy future needs for energy transmission and are identified by the 1993 Western Utility Group (WUG) Western Regional Corridor Study.

3.6.5 Land Consolidations

Land is consolidated through fee or easement acquisition, exchange, condemnation, and donation processes. Currently, there are no active efforts to consolidate land within the RMPPA. However, proposals are currently being evaluated, and RFO staff members will consider any proposal in relation to land exchange criteria (Appendix 6), determining future action based on the proposal's merits.

3.7 LIVESTOCK GRAZING

The livestock grazing on BLM-managed public lands are primarily cattle, but also include sheep, and to a lesser extent horses and bison. The numbers of these grazing livestock have varied in response to their economic value as a commodity (cattle, sheep, and bison) and their use in ranching operations (horses).

3.7.1 Historic Use

Livestock first entered Wyoming during the 1840s as people moved westward along the trails to California, Oregon, and Utah. However, livestock associated with permanent ranching operations were not established until the transcontinental railroad was constructed during the 1860s. Cattle initially were the principal type of grazing animal, but the severe winter of 1886–87 opened the door for sheep operations, which was the dominant livestock use until after World War II. Sheep numbers have steadily declined since the 1940s and now amount to about one-third of the current cattle numbers. Figure 3-34 outlines the state trends in sheep and cattle numbers since 1920, which should also be representative for the Rawlins RMPPA. In 1920, 24.1 percent of the livestock were cattle, dropping to 17.7 percent in 1940, and then rising to 73.5 percent in 2000. Horses, although never as numerous as sheep and cattle, were more common in the first half of the century before motorized vehicles reduced ranchers' reliance on them. Bison, which were nearly eliminated as a species prior to 1900, have been returned to their native ranges by a few private operations since the 1980s.

Congressional legislation has played an important role over time in guiding the management of public rangelands. The Taylor Grazing Act of 1934 ended the status of unregulated common lands by laying out a process to establish livestock grazing districts and carrying capacities. Inventories conducted between the 1940s and 1960s were used to adjust livestock stocking rates, and the first allotment management plans in the RMPPA were developed in the late 1960s. The Federal Land Policy and Management Act of 1976 defined BLM's multiple-use mandate with management balanced among all resources values, and led to more defined and standardized land use plans and inventories that were conducted from the late 1970s to the mid-1980s. Management of riparian and wetland habitat, which had been lacking in previous allotment plans, became a focus for livestock management following these efforts.

3.7.2 Current Use

The percentage of actual use by cattle and sheep on public lands over a recent 10-year period (1991–2000) is presented in Table 3-5. The average use by all livestock in this table is about 274,000 animal unit months (AUM), with a range from 187,755 to 344,572 AUMs. The rise in livestock use depicted in this table occurred following a very dry period between 1988 and 1991. Although this region continues to reflect a long-term hydrologic drought documented through river and stream flow measurements, the amount and timing of precipitation through this period were generally good for forage growth to support livestock grazing. Livestock use typically varies due to forage conditions, market prices, and changes in livestock operations. Since most of these operations have existed for three to four generations, adjusting to varying climate conditions, including drought, is a normal aspect of annual grazing management. In addition to modifying livestock numbers and use, other practices include locating additional pasture, weaning and/or shipping early, and increasing the use of irrigated, private lands.

Table 3-5. Livestock Actual Use in Animal Unit Months (AUM) for the RMPPA from 1991 to 2000

Year	Cattle Actual Use (AUMs)	Sheep Actual Use (AUMs)	Total Actual Use (AUMs)	Percent Cattle Use (AUMs)
1991	158,670	29,085	187,755	84.5%

Year	Cattle Actual Use (AUMs)	Sheep Actual Use (AUMs)	Total Actual Use (AUMs)	Percent Cattle Use (AUMs)
1992	173,422	29,015	202,437	85.7%
1993	212,129	37,496	249,625	85.0%
1994	224,270	32,503	256,773	87.3%
1995	228,893	31,172	260,065	88.0%
1996	280,655	31,433	312,088	89.9%
1997	278,748	30,977	309,725	90.0%
1998	273,561	26,591	300,152	91.1%
1999	318,098	26,474	344,572	92.3%
2000	294,329	21,855	316,184	93.1%
Mean Actual Use	244,278	29,660	273,938	89.2%

Several other recent factors that influence livestock numbers and management have been high numbers of wild horses that exceeded appropriate management levels, large increases in elk populations across Wyoming and neighboring states, and expansion of invasive poisonous plants due to surface disturbance activities relating to oil and gas development. Voluntary nonuse of livestock AUMs in the Adobe Town Wild Horse Herd Management Area (HMA) from 2002 to 2004 amounted to 50 percent, 80 percent, and 90 percent of the livestock preference (approximately 26,000 AUMs) in allotments within the HMA boundary. Additional loss of AUMs occurred in allotments outside the HMA as wild horses moved to find forage and water. Elk populations have increased several-fold across Wyoming, and interstate herds move between this state and Colorado, Idaho, Montana, and Utah. Elk prefer to eat grasses and therefore have a high overlap in diet with both cattle and wild horses. Elk and wild horses often share the same winter range and must be factored into livestock grazing management and range condition. Expansion of poisonous invasive species like Halogeton may also lead to higher levels of nonuse, particularly by sheep and to a lesser extent by cattle (see weeds section for further discussion). The trend of shifting from sheep to cattle, discussed under 3.7.1, Historic Use, has continued (based on licensed livestock use within the Rawlins RMPPA). The percentage of cattle use, in AUMs has increased from 84.5 percent in 1991 to 93.1 percent in 2000.

There is a total of 582 grazing allotments within the Rawlins RMPPA (Table A29-1 in Appendix 29 and Map 3-3). These are spread across 3,492,744 acres of public land (52.9 percent), other federal land (0.8 percent), state land (5.3 percent), and private land (40.9 percent). Allotments range in size from 20 acres to 291,954 acres of public land. There are 222 allotments that contain 640 acres (one section) or less of public land, 160 allotments that contain between 640 and about 2,500 acres of public land, 115 allotments that contain between 2,500 and 10,000 acres, and 80 allotments that each contain more than 10,000 acres of public land. These 80 allotments make up 76 percent of the public land in the Rawlins RMPPA. The public and other federal lands that BLM administers grazing upon provide 469,575 AUMs for grazing use. The number of AUMs continues to fluctuate for various reasons. Reductions occur as a result of such actions as sheep-to-cattle conversions or following changes in season or duration of use. Over the past 15 years, there have also been increases in AUMs, with an additional 4,225 AUMs becoming available due to improvements in management and forage availability. Other actions taken to achieve the objectives identified in the land use plan include the use of best management practices in activity plans for livestock, wild horses, and watershed and other managed resources.

Of the 582 allotments in the Rawlins RMPPA, 87 percent are used by cattle alone, 9 percent are used by cattle and sheep, and 1.4 percent are used by sheep alone. Cattle share five allotments with licensed domestic horses, there is one allotment with cattle and bison, four allotments are used by horses alone, and one is used by goats. Small numbers of horses used in ranching operations are also licensed in other

allotments. Nine allotments currently do not have permitted livestock use. Two of these are wildlife management units where the private lands are controlled by the Wyoming Game and Fish Department (WGFD), and grazing use is authorized on a temporary, non-renewable basis in conjunction with WGFD. Other private lands with attached public land grazing have been purchased by individuals who are not in the livestock business. The public lands in these allotments are relatively small, and may be managed for other resource or uses (i.e., wildlife habitat or recreation), incorporated into a neighboring allotment, or identified for sale or exchange. Table A29-1 in Appendix 29 outlines the public, other federal, private, and state acreage per allotment; the total federal AUMs; the class of livestock; the timing of grazing; and the grazing management of each allotment.

Improvement projects and grazing systems, which have become known as “best management practices” (BMP) have been under way for the past 40 to 50 years. These efforts have occurred singly or cooperatively among livestock permittees, the University of Wyoming Extension Service, and state and federal agencies. The efforts have been further improved over the past 10 years through education workshops and seminars, federal and nonprofit cost-sharing opportunities, and more active participation by local conservation districts in all aspects of this process. The goal of such efforts is to enable sustained livestock use without damaging the vegetation and watershed resource while supporting the presence of healthy wildlife, fish, and wild horse populations. Grazing management plans are devised with consideration of other resource values, vegetation production and type, topography, water locations, and needs of the livestock owner.

Historic priorities for improved livestock management usually addressed the larger blocks of public land, followed by resource issues, particularly condition of watersheds in general, and, more recently, riparian habitat. Of the 80 largest allotments, 75 percent have grazing systems or adequate management for the resources present. These allotments received the majority of attention since 1983 under the previous national direction and RMP ranking of allotments into I (improve), M (maintain), and C (custodial) categories. This old system of ranking allotments has been replaced with the rangeland health assessments developed during the mid-1990s. These assessments, including the current guidance for evaluating rangeland standards on a watershed basis, will widen the management focus to all problem areas that relate to meeting these standards, with less emphasis on the amount of public land involved and no limitation to just the impacts from livestock grazing. The process of reviewing all allotments, resolving management issues, and monitoring to document change will result in less focus on (more-intensive) allotment management plans. In the first 8 years of evaluating Standards for Healthy Rangelands, 396 allotments (3.3 million acres of public land) have been assessed, with 73 allotments (18 percent) failing to meet one or more standards due to livestock management. Adjustments to livestock management have already occurred on three out of every five allotments, most of which relate to the Riparian/Wetland Habitat Health Standard due to the season and/or duration of livestock use. Standards have also not been met due to wild horse use, wildlife use, oil and gas development, weed expansion, gradient adjustments, and plant succession/community decadence. (See Appendix 8, Monitoring Methods to Assess Wyoming Standards and Guidelines for Healthy Rangelands).

Grazing systems are defined in the following seven categories:

- **Permit Long.** Grazing occurs for part of or for the duration of the permitted time, often lasting from late spring through fall.
- **Year-Long Permit.** Grazing is permitted for any time during the year.
- **Rotation.** Grazing is rotated during the growing season between pastures in the allotment to provide partial growing season rest before use or recovery time after use.
- **Deferred Rotation.** Grazing is rotated between pastures or allotments to provide full growing season rest every second or third year.

- **Dormant Season.** Grazing occurs after seed-set by grasses; includes late summer, fall, and/or winter grazing.
- **Split Season.** Grazing occurs during two separate time periods, by removing livestock from the allotment and returning them later in the year to provide partial growing season rest.
- **Rest Rotation.** Grazing is rotated between pastures, with each pasture receiving no grazing use for an entire year, usually every third or fourth year.

Within the Rawlins RMPPA, 56 percent of allotments are used on a permit-long basis, 20 percent are managed with a deferred rotation system, and 16 percent are managed with a rotation system. Four percent of allotments are permitted for year-long use that often are used as utility pastures when needed. Dormant season, split season, and rest rotation management systems make up the balance of the allotments, in order by their percentage of use. Although the majority of allotments are listed as used on a permit-long basis, this should not be interpreted as ineffective management. As described above, 38 percent of allotments contain 640 acres or fewer of public land and 58 percent of allotments contain 2,500 acres or fewer of public land. These areas have received the least amount of attention from BLM in the past, but the private owners, often in conjunction with conservation districts or the Natural Resources Conservation Service, implement management plans on their own. The emphasis for livestock management within the Rawlins RMPPA is to promote partial growing season rest by livestock on all allotments to maintain or improve plant vigor and health.

The single most contentious issue relating to livestock grazing is fencing. As a result of the historically high numbers of sheep grazing in this region, the favored type of fence construction was 24- to 32-inch mesh fence with two-three barbed wires on top. Although very practical in helping herders control sheep, this type of fence is difficult for small animals and antelope in general to pass under or through, and can also catch mule deer and elk due to the close wire spacing at the top. With the conversion of most grazing operations from sheep to cattle, the need for these sheep-tight fences is gone. Current fence standards provide for three and four wire fence constructions that are more favorable for wildlife movement while still providing for control of cattle. Exceptions are made where cattle are more concentrated, including areas such as roundup pastures, riparian exclosures, and drainage crossings. However, the amount of fencing needed to be converted is estimated at over 1,000 miles. Fences are being converted in priority areas, where there are partners involved, as older fences need to be replaced, and as labor and funding allow. Over the past 10 years, 26 miles of fence have been converted.

3.7.3 Results of Rangeland Best Management Practice Application

Rangeland BMPs have been implemented since the 1980s on many allotments to solve problems particular to vegetation type, topography, availability of water, and the needs of the grazing operations. The following subsections present examples of successful BMPs used on individual allotments to improve grazing and ecological stability (selected by range staff who work on the allotments) and describe the management change and results in these allotments.

Pine Grove-Bolten Allotment

The 277,369 acres of the Pine Grove/Bolten Allotment include public (120,012 acres), private (148,017 acres), and state (9,340 acres) holdings. Grazing management has improved, and resource-oriented objectives have been established with the current permittee. Many range improvements have been completed within the allotment, which have greatly supported grazing flexibility. These include additional fencing (55 miles, 34 of which are electric) that has resulted in more than 50 pastures within the allotment instead of the original 21 large pastures. Many water developments have also been completed: 70 wells, 30 miles of pipelines, 18 spring developments, and 11 reservoirs. A long-term vegetation treatment program to diversify habitat has also been developed; during 2001–2003, 12,100 acres were treated with

tebuthiuron (Spike), and a prescribed burn is being planned. Control of noxious weeds through a cooperative effort of BLM, Carbon County Weed and Pest, and the livestock operator is ongoing. WDEQ-WQD has determined that McKinney and Sage Creek have impaired water quality within the allotment. Both of these streams drain areas of highly erosive shale formations (Niobrara), and in turn carry sediment loads that exceed beneficial use standards. Because the current permittee has improved grazing management, portions of McKinney Creek have been removed from the Wyoming 303(d) list of impaired streams. Work continues along Sage Creek, including intensive water quality monitoring and improvements on diversions that were engineered to reduce siltation. The permittee has hired consultants who, along with BLM, monitor range conditions and improvements in the allotment.

Riner Allotment

The 56,962 acres of the Riner Allotment include federal (26,530), private (28,998 acres), and state (1,434 acres) holdings. Water development, improved livestock management, and electric fences are management practices that have been implemented in the Riner Allotment. The current permittee acquired the permitted use on public land within the Riner Allotment in 1993. The allotment is in a mixed-ownership, checkerboard land pattern, with less than 50 percent public land. The permittee immediately changed the livestock management from essentially a permit-long use cycle to rotation, especially within the largest pasture. To accomplish this, existing water sources were improved and additional water sources were developed, on both public and private land. The rotation within the largest pasture initially relied on extensive herding of livestock, which soon proved impractical. Electric fences have since been constructed to split the largest pasture into five smaller pastures. With these changes, conditions near the water sources that existed prior to 1993 have greatly improved. Conditions throughout the allotment also appear to have improved.

Beaver Hills Allotment

The 4,832 acres of the Beaver Hills Allotment include public (960 acres) and private (3,872 acres) holdings. Although the Beaver Hills Allotment was originally categorized as Custodial, the current livestock operator is enthusiastic about developing a cooperative management plan for the unit, with the goal of benefiting the livestock operation as well as important big game species habitat. A deferred rotation grazing system is currently employed on the allotment; this system uses short-duration grazing treatments after early summer but before moving the livestock onto summer USFS grazing allotments. A prescribed burn was completed during 2002 and 2004 in four pastures to improve forage conditions, wildlife habitat values, and watershed health. Several spring developments are planned to protect important riparian habitat and to improve livestock distribution. Cooperators include BLM, WGFD, the landowner, and Natural Resources Conservation Service (NRCS). Important big game habitat, including bighorn sheep winter range, winter and crucial winter elk range, and transitional habitat for mule deer, will be enhanced through this process.

Doty Mountain Allotment

The 84,008 acres of the Doty Mountain Allotment include public (59,504 acres), private (22,904 acres), and state (1,600 acres) holdings. The main stem of Muddy Creek flows through the Doty Mountain Allotment in the southwestern portion of the Rawlins RMP. Objectives established on the Doty Mountain Allotment included enhanced bank cover, increased stream width-to-depth ratio, improved herbaceous species composition, riparian shrub regeneration, decreased upland shrub density and diversified age structure, and improved waterfowl habitat. These objectives were attained through improving livestock distribution, deferring grazing past the hot season, and creating riparian pastures. Implemented BMPs included converting the two-pasture rotation to a nine-pasture rotation, which defers grazing in five riparian pastures until late summer or early fall. Use of the remaining pastures varies from 2 to 10 weeks, depending on pasture size and the season of use. Ongoing research on sensitive fish

species in Muddy Creek will be incorporated in future adjustments to livestock management. Range improvements include 10 upland water developments and 28 miles of pasture fencing, as well as 2 well and pipeline projects. Range vegetation on 3,500 acres was treated using burns and Spike. Constructed ponds and wetlands created 220 acres for wildlife habitat as well. Photographs, vegetation inspections, and riparian cross-section survey data show major improvements in bank cover, channel morphology, and enhanced species composition. Livestock conception rates have also improved.

Grizzly Allotment

The 38,091 acres of the Grizzly Allotment include public (27,533 acres), private (1,226 acres), and state (9,332 acres) holdings. WGFD controls the private land within this allotment and leases the cattle use to a private livestock operator. Before 1990, a rest rotation system was in place with seven pastures. There are currently 12 pastures and several new water developments, such as spring improvements and reservoir construction. Recent vegetation treatments, consisting of three prescribed burns and two Spike treatments, have reduced shrub cover and increased herbaceous plant diversity. Improvement in both riparian and upland conditions has resulted, and the recent allotment evaluation suggested that there is increased vegetation production in the allotment. Littlefield Creek and Muddy Creek within the allotment have both been removed from the Wyoming 303(d) list of impaired streams. The Grizzly Allotment was the primary target for the reintroduction of Colorado River cutthroat trout (a sensitive species); a portion of this effort was completed in 2001, with the remainder achieved in 2006.

Monument Draw Allotment

The 15,417 acres of the Monument Draw Allotment include only public holdings. Livestock management, water development, and vegetation treatment are a few of the BMPs instituted within the allotment. A new permittee acquired the permitted use within the allotment in 1997. The season of use was extended, with a more intensive management system using the two existing pastures and available water sources. Additional water sources were needed for the more intensive management. The new permittee cleaned and repaired existing reservoirs and also extended a livestock water pipeline. Livestock watering sources continue to be developed, including additions to the pipeline. The allotment had also been identified as having areas of excessively high sagebrush cover, especially on the plateau in the southeast third of the allotment. A Spike treatment was conducted in 2003 affecting 1,500 acres. The management changes have improved ground cover to more than 75 percent in an area with limited rainfall.

Powder Rim Allotment

The 46,812 acres of the Powder Rim Allotment include public (46,532 acres) and private holdings. The original Powder Rim Allotment Management Plan (AMP), implemented in the late 1960s, proved to be impractical because of conflicting uses and increased activation of previously rested (voluntary nonuse) privileges. As a result of the livestock permittees' concerns about declining forage conditions and a Standards and Guidelines (S&G) review of the allotment, the AMP was revised in 2001 to take into account current conditions and issues. Two permittees were split from the allotment and allocated use in separate pastures. Improvements currently being developed in these pastures include 6 to 7 miles of fencing, several new water developments (two wells, one spring development, and several small pit reservoirs), and two separate vegetation treatments. In addition, split season livestock use, designed to rest the vegetation during the peak growing season and defer use until late fall, has been initiated in two pastures. Three other pastures in the rotation receive split season and deferred summer cattle use in conjunction with winter sheep use. Fencing of two natural spring sites, determined to be nonfunctional during the S&G review, resulted in increased flow and water quality. Protecting the associated riparian areas improved stream and riparian stability. One additional spring-seep complex will be developed, and several water wells will be completed to provide reliable, controllable water in dry portions of the

pastures. Management in the pastures will enhance habitat for mule deer and elk, including crucial winter range.

Bar Eleven Allotment

The 54,256 acres of the Bar Eleven Allotment include public (51,570 acres), private (1,635 acres), and state (1,051 acres) holdings. In the Bar Eleven Allotment, objectives were set to reduce the stream width-to-depth ratio, increase riparian shrub regeneration, change herbaceous species composition from Kentucky bluegrass to Nebraska sedge, reduce bare areas in the riparian areas, and increase trout size and population. Implemented BMPs included adjustments to the duration of use from June through September by the fencing of three additional pastures. This action reduced grazing duration from 4 months to 1 month or less. Riparian pastures were established on Pete Creek to limit grazing to the fall to enhance recreational use and habitat for brook trout. The remaining upland pastures now employ a deferred rotation grazing system. Grazing distribution was improved with the installation of proper pasture fencing and upland water improvements. Recent monitoring data, such as photo point pictures, riparian cross sections, and vegetation inspections, have shown improvement due to the actions above. The BMP measures resulted in narrowing stream widths, improving stream bank cover, diversifying riparian and upland vegetation, and increasing willow regeneration.

3.8 MINERALS, GEOLOGY, AND TOPOGRAPHY

This section describes the geologic and mineral resources found within the RMPPA. Specific topics include geologic units; topography; and the leasable, locatable, and common variety minerals found within the RMPPA. Unless otherwise noted, the information in this section is based on the Mineral Occurrence and Development Potential Report (ENSR and Booz Allen Hamilton 2002), which was prepared in support of this planning process.

3.8.1 Geologic Units

The formations in the RMPPA range in age from Precambrian to recent. In the eastern Green River Basin, at the western edge of the RMPPA, the total thickness of sedimentary rock is about 30,000 feet in the Washakie Basin (Kent 1972). The Hanna Basin contains a thick sequence of post-Precambrian rocks that is estimated to be greater than 42,000-feet thick (Law 1995). Precambrian rocks are generally exposed in the cores of the mountain ranges and smaller uplifts, such as the Rawlins Uplift. In southeastern Wyoming, in the northwest portion of the Denver-Cheyenne Basin, the sedimentary rock section is slightly more than 10,000-feet thick (Kent 1972). Paleozoic, Mesozoic, and Cenozoic rocks are exposed throughout the RMPPA.

The Precambrian rocks that are exposed in the mountain ranges are complex assemblages of igneous and metamorphic rocks (Houston 1993). Nearly all Paleozoic and younger rocks are sedimentary. The Paleozoic formations were mostly deposited in a shallow marine environment and include limestone, dolomite, sandstone, and shale. Cambrian rocks are present in the west and northwest portions of the RMPPA (Boyd et al. 1993). There are no widespread rocks representing Ordovician through Devonian because these layers were eroded after being deposited. The Mississippian System is represented by the Madison Limestone and the Darwin Sandstone in the western portion of the RMPPA. The Mississippian rocks thin from west to east until eventually they are absent east of the line from Centennial, Wyoming, to northwest Laramie County (Boyd et al. 1993). Pennsylvanian rocks in the RMPPA consist of the Amsden Formation, the Tensleep Sandstone, the Casper Formation, and the Fountain Formation. In the western part of the RMPPA, Permian rocks are represented by the Phosphoria Formation and the Goose Egg Formation. Triassic and Jurassic rocks alternate between marine and continental environments. The Dinwoody Formation, the Chugwater Group, and the Nugget Sandstone represent Triassic rock in the western and northern parts of the RMPPA. Jurassic formations throughout the RMPPA consist of the Nugget Sandstone, Sundance, and Morrison Formations. In the eastern Hanna Basin at Como Bluff, outcrops of the Morrison Formation have yielded abundant dinosaur bones (Mears et al. 1986). Cretaceous rocks include sandstones, siltstones, and shales that were deposited as the western edge of a shallow interior seaway transgressed westward and retreated eastward several different times. The lower part of the lower Cretaceous is represented by sandstones that are loosely correlated and referred to as the Lakota Sandstone and the Fall River Sandstone (Inya Kara Group) or Cloverly Formation. Above the Lakota and the Fall River sandstones is the Thermopolis Shale. Above the Thermopolis Shale is the Muddy Sandstone (Watson 1980).

In the western parts of the RMPPA, the Upper Cretaceous consists of the Mowry Shale, the Frontier Formation, the Niobrara Formation, the Steele (Baxter) Shale, the Mesaverde Group, the Lewis Shale, Fox Hills Sandstone, and the Lance Formation. The Mesaverde Group designates widespread sedimentary rocks in the Greater Green River Basin, consisting of sandstone, carbonaceous shale, and coal (Ver Ploeg 1992). The Lance Formation is made up of carbonaceous shale, sandstone, siltstone, mudstone, and coal (Watson 1980). In the Hanna, Shirley, and Laramie Basins, the most recent upper Cretaceous units are the Medicine Bow and Ferris Formations, which are composed of carbonaceous shale, coal, mudstone, and sandstone. In the Denver-Cheyenne Basin portion of the RMPPA, the lowest Upper Cretaceous units, in ascending order, are the Graneros Shale, the Greenhorn Formation, the Carlile Shale, and the Niobrara

Shale overlain by a dark gray marine shale called the Pierre Shale. Overlying the Pierre Shale is the Fox Hills Sandstone. The Fox Hills Sandstone documents the last retreat of the Cretaceous interior seaway from Wyoming toward the east. The Lance Formation and all later Tertiary and Quaternary formations were deposited in continental environments by rivers, streams, swamps, and lakes, as well as by wind and glaciers in some areas. The Lance Formation overlies the Fox Hills Sandstone in the northern part of the Denver-Cheyenne Basin (Lilligraven 1993).

The earliest Tertiary rocks (Paleocene Series) in the western portions of the RMPPA are in the Paleocene Fort Union Formation, which is composed of sandstone, conglomerate, shale, and coal (Watson 1980) deposited in the intermountain basin. In the Hanna, Shirley, and Laramie Basins, the Paleocene is represented by the Ferris and Hanna formations (carbonaceous shale, sandstone, conglomerate, and numerous coalbeds). The Hanna Formation extends into the Eocene Series rocks. There are no lower Tertiary rocks in the Denver-Cheyenne Basin (Lilligraven 1993). Eocene Series rocks in the western part of the RMPPA are the Wasatch Formation (mudstone, red sandstone, carbonaceous shale, and sub-bituminous coal [Watson 1980]) and the Green River Formation (shale, oil shale, marlstone, and occasional sandstone). In the Shirley and Laramie Basins, the Eocene is represented by the Wind River Formation (sandstone, conglomerate, mudstone, carbonaceous shale, and minor coal [Watson 1980]) and Wagon Bed Formation. In the Denver-Cheyenne Basin, there are no Eocene rocks (Love et al. 1993). The Oligocene White River Formation is present in the western part of the RMPPA and in the Hanna, Shirley, and Laramie Basins. The White River in the Denver-Cheyenne Basin may contain vertebrate fossils in isolated localities (Watson 1980). In the western parts of the RMPPA, the Miocene is represented by the Browns Park Formation and the Split Rock Formation. In northeastern Laramie County, the Miocene Arikaree Formation and the upper Oligocene are present. In the Denver-Cheyenne Basin, the Miocene Ogallala Formation covers the surface in most of Laramie County (Love and Christiansen 1985). Unconsolidated Quaternary deposits consist of alluvium, terraces gravels, colluvium, pediments, and glacial deposits (Love and Christiansen 1985). Alluvial deposits are generally associated with alluvial valleys of the major rivers and tributaries. Glacial deposits are limited to the Medicine Bow Mountains and the Sierra Madre and are largely composed of boulders, cobbles, and fine materials that were scoured from the mountains by the glaciers. More detail on geologic units can be found in the RMPPA Minerals Report.

3.8.2 Structural Geology and Tectonics

Map 3-4 shows the major structural elements of the RMPPA. The Laramie Range, Medicine Bow Mountains, Sierra Madre, and Sweetwater Arch are composed of Precambrian, Paleozoic, Mesozoic, and early Tertiary rocks that have been uplifted as the rock layers were compressed into anticlines and uplifted along low-angle thrust faults and high-angle reverse faults. Most of the uplift occurred 75 to 50 million years ago in latest Cretaceous and early Tertiary time. This mountain-building period, known as the Laramie Orogeny, occurred through much of the Western states of Wyoming, Colorado, Utah, Montana, Arizona, and New Mexico (Snoke 1993).

The cores of the ranges contain Precambrian rocks that have been uplifted many thousands of feet through movement on low-angle to high-angle reverse faults. The adjoining basins are generally deepest at the thrust front. Igneous and metamorphic rocks in the mountainous regions are resistant to weathering, but eventually break down physically and chemically to form the thick accumulations of sedimentary rocks that fill the adjacent basins.

In addition to the major mountain ranges, there are secondary scale uplifts with Precambrian cores within the RMPPA, such as the Ferris, Seminoe, and Shirley Mountains and the Rawlins Uplift. The Rawlins Uplift is an asymmetric anticline bounded by a reverse fault on the west. An anticline is a geologic structure in which the rocks have been folded in a convex upward shape (Gary et al. 1974). The third scale of uplift or anticlines is located on the platforms between the basins and the secondary uplifts and along the major basin margins. These anticlines are generally asymmetric and faulted at depth and

provide traps for hydrocarbons. The structural style generally comprises a series of anticlines, such as the Lost Soldier-to-O'Brian Springs complex, that are related to the adjacent major uplift, or the Ferris–Seminoe trend. Another complex is the Oil Springs-to-South Big Medicine Bow, which is a structural divide between the Hanna and Carbon Basins. A third complex is the Rock River-to-Quealy Dome series of anticlines that mark the front between the Medicine Bow Mountains and the Laramie Basin. Oil and gas was first discovered in the RMPPA in the third scale of anticlines starting in 1916 at the Lost Soldier anticline. These structural oil and gas fields are very mature and will probably be depleted within the next 20 years unless new applications, such as carbon dioxide (CO₂) sequestration, are initiated. The platform areas between the major structural elements have been only lightly explored in relation to stratigraphic traps, and these may be discovered in the future.

In addition to major faults at the boundaries of the mountain ranges and smaller uplifts, there is a major shear zone in the RMPPA called the Cheyenne Belt (Map 3-4). The Cheyenne Belt is a series of southwest-to-northeast-trending fault blocks that cut through the Precambrian rocks of the Sierra Madre, the Medicine Bow Mountains, and the Laramie Mountains (Houston 1993). The Cheyenne Belt separates metamorphic sedimentary rocks that are among the oldest on the North American continent, on the north side, from much younger, largely igneous rocks to the south of the belt.

On the west side of the RMPPA are sub-basins on the eastern edge of the Greater Green River Basin called the Washakie Basin and the Great Divide Basin. The Washakie and Great Divide Basins are separated by a structural high called the Wamsutter Arch, which generally trends from west to east paralleling I-80. The Washakie Basin is bounded on the south by another west-to-east-trending structural high called the Cherokee Arch. The Cherokee Arch lies generally along the Wyoming-Colorado state line and separates the Washakie Basin from the Sand Wash Basin in northwest Colorado (Law 1995). Other, smaller basins entirely within the RMPPA are the Hanna, Shirley, and Laramie Basins. In the eastern part of the RMPPA is the Denver-Cheyenne Basin, which occupies northeast Colorado, southwest Nebraska, and the southeastern corner of Wyoming.

3.8.3 Topography

The RMPPA is located in three major physiographic provinces: the Wyoming Basin, the Southern Rocky Mountains, and the Great Plains (Howard and Williams 1972). The western and northwestern portions of the RMPPA are located in the Wyoming Basin, a 40,000-square-mile area that includes much of southwestern Wyoming and part of northwestern Colorado. The Wyoming Basin Province is typified by topographic and structural basins that are either bounded by mountains in the adjacent provinces or bounded by ranges within the province itself (Map 3-4). There are several west-east-trending mountain ranges in the north-central part of the RMPPA. The ranges are, from west to east, the Ferris Mountains, the Seminoe Mountains, and the Shirley Mountains. The Ferris Mountains rise to 10,000 feet elevation above sea level, whereas the Seminoe and Shirley Mountains peak at about 9,500 feet above sea level.

Sub-basins of the Wyoming Basin within the RMPPA boundaries include the Washakie and Great Divide basins of the eastern Greater Green River Basin, the Hanna Basin, the Shirley Basin, and the Laramie Basin. In the basin areas, the topography is typified by extensive prairies that intersect with badlands, playas, and sand dunes (Howard and Williams 1972).

Elevations in the Wyoming Basin portion of the RMPPA generally range from 6,500 to 7,500 feet elevation above sea level. The Great Divide Basin is bounded by branches of the Continental Divide and has no external drainage outlet. Major river drainages in the Wyoming Basin portion of the RMPPA are the North Platte River, Laramie River, and Little Snake River. All these rivers have their origins in the Southern Rocky Mountains.

A small part of the Southern Rocky Mountains Province is in the south and south-central portions of the RMPPA. The Southern Rocky Mountains extend through northern New Mexico, Colorado, and southern Wyoming. Mountain ranges in the RMPPA consist of the northernmost portions of the Southern Rocky

Mountains. Those ranges are the Laramie Mountains, the Medicine Bow Mountains, and the Sierra Madre (the northern extension of Colorado's Park Range). The portions of the RMPPA on the flanks of the mountains generally range from 7,500 to 8,000 feet elevation above sea level. The highest point in the RMPPA is Medicine Bow Peak, at 12,013 feet elevation above sea level. In many places, hogback ridges mark the flanks of the mountain ranges.

The eastern portion of the RMPPA is located in the Great Plains Province, in a subprovince called the High Plains (U.S. Geological Survey [USGS] 1970). The High Plains are characterized by nearly flat-lying Tertiary deposits, with mesas and badland topography. A prominent physiographic feature in southeastern Wyoming is called the "Gangplank," so-called because the Tertiary rocks form a long, sloping surface up to the 7,000-foot level of the Laramie Range (Howard and Williams 1972). Elevations in the High Plains portion of the RMPPA range from 7,000 feet above sea level on the east flank of the Laramie Range to less than 5,000 feet above sea level in northeastern Laramie County.

In the High Plains portion of the RMPPA, drainages originate in the Laramie Range and flow from west to east. The important drainages from south to north include Crow Creek, Lodgepole Creek, Horse Creek, and Little Bear Creek. Crow Creek eventually empties into the South Platte River in Colorado. The other drainages are in the North Platte River Basin.

3.8.4 Mineral Resources

Terms used in the management of mineral resources on federally administered lands within the RMPPA include the following:

- **Leasable Minerals.** These include energy and non-energy minerals regulated under the Mineral Leasing Act of 1920 as amended, which excluded them from the Mining Law of 1872. Coal, oil, gas, and trona are examples of the minerals included. The Geothermal Steam Act of 1970 added geothermal energy to the list of leasable minerals. Leasable minerals are available through a system of competitive and non-competitive leases.
- **Locatable Minerals.** These include all minerals subject to exploration, development, and production under the provisions of the Mining Law of 1872. They include both metallic and non-metallic minerals such as gold, silver, specialty clays, and zeolites. Locatability is determined by a case-by-case validity examination.
- **Common Variety Minerals.** These are regulated by the Federal Materials Act of 1947 and the Multiple Surface Act of 1955. Common variety minerals may be obtained by a free use permit by federal, state, and local governments and qualified nonprofit groups. Sales must be obtained for common variety minerals by commercial and private entities. Examples include sand, gravel, pumice, and common dimension stone. Petrified wood is also a common variety mineral for which a sale must be obtained. Small amounts of petrified wood may be collected for recreational and rockhounding purposes without a permit.

Leasable Minerals

Oil and Natural Gas

Gas is defined by 43 CFR 3000.0-59(a) as a fluid, either combustible or noncombustible, which is produced in a natural state from the earth and which maintains a gaseous or rarified state at ordinary temperatures and pressure conditions. Conventional natural gas in the RMPPA can be contained in sandstone, limestone, or shale reservoirs, while coalbed natural gas is contained in coal reservoirs. In discussing oil and gas leasing, 43 CFR 3100.0-3 does not distinguish between these two types of reservoirs. All other aspects of the regulation of oil and gas such as Onshore Orders 1, 2, 3, 5, and 7 and

Notice to Lessee 3A and 4A also do not distinguish between the two types of reservoirs. Coalbed natural gas development is separated for impact analysis because of issues related to produced water, well spacing, and associated surface disturbance.

The majority of the oil and gas fields are located in the western portion of the RMPPA (Map 3-5). Based on production figures through the year 2000, 3 of Wyoming's top 25 gas-producing fields are within or partially within the RMPPA. These fields and the associated year 2000 production rank within Wyoming are as follows: Standard Draw (10), Wild Rose (14), and Wamsutter (16) (Wyoming Oil and Gas Conservation Commission [WOGCC] 2002). In addition, the RMPPA contains 2 of the top 25 oil fields in the state: Lost Soldier (3) and Standard Draw (24).

Records indicate that before 1910 only one well had been drilled in the RMPPA. Since that time there has been a pronounced upward trend in the number of wells drilled (ENSR and Booz Allen 2002). As the number of wells drilled has increased during this period, the depth of the wells also has increased. Since 1990, 74 percent of the wells drilled have been between 8,000- and 12,000-foot deep. The average total depth was 9,249 feet.

As of October 2003, the RMPPA contained 2,690 wells (WOGCC 2003). Since 1980, 37 percent of the total number of wells drilled in the RMPPA have been abandoned. Abandoned wells are either unproductive (dry holes) or have become depleted and are no longer economical.

Within the RMPPA, drilling activity has been concentrated in three regions. The first and most heavily drilled region is in the eastern Greater Green River Basin, including the Great Divide Basin, the Wamsutter Arch, and the Washakie Basin. This region is located in the westernmost part of the RMPPA. Despite the heavy drilling in parts of these areas, some townships in this region have been only lightly tested. The primary objectives in these areas are stratigraphic traps within the Upper Cretaceous. Map 4-7, Oil and Gas Project Locations with Oil, Gas, and Coalbed Natural Gas Potential, identifies the regions in the RMPPA where the majority of oil and gas activity has occurred and is likely to occur in the future.

The two other regions of concentrated activity lie in the eastern part of the RMPPA and in a region across its center. These regions have been less heavily explored and developed than the region in the west. Many townships within these two regions have been only lightly tested. The primary objectives in the eastern region are stratigraphic traps in the Lower Cretaceous and fractured reservoirs in the Upper Cretaceous. The central region is mainly developed in structural traps that may include production from the Precambrian to the Upper Cretaceous. The central region is very mature, and unless stratigraphic traps are discovered, it will not be very active in the future. Outside of these three drilling activity regions, many townships have not been tested.

Gas production was flat beginning at least as early as 1974, but it began a steady increase in 1978 that carried through 1981 (ENSR and Booz Allen 2002). After a period of fluctuation during 1982–1985, production increases resumed. From 1986 through 1997, production increased at a nominal annual rate of 4.2 percent. Gas production was 7.5 times higher in 2001 than in 1974. A decline in production during 2000 was mostly caused by a decline in production from private wells. Gas production from the RMPPA in 2001 represented 11 percent of Wyoming's total gas production, based on data from WOGCC.

From 1978 to 1990, oil production fluctuated around an annual rate of 8 million barrels. Beginning in 1990, annual production declined, and it has continued to decline at a nominal rate of 2.8 percent annually through 2001. About half the oil produced in the RMPPA during 2000 and 2001 was from the Lost Soldier-Wertz Fields near Bairoil. This field complex is in a tertiary phase of oil recovery via CO₂ injection, and it is expected that no future oil production enhancement can be accomplished. In 2001, only 7 percent of Wyoming's total oil production came from the RMPPA.

Although there is increased interest in exploration for and development of gas resources in coalbeds within the RMPPA, there has been little production. Only 0.179 billion cubic feet (BCF) of gas and 10.3 million barrels of water had been produced in the RMPPA as of January 2002 (WOGCC 2002).

Exploration for gas reserves in coalbeds is progressing in Atlantic Rim, along Seminoe Road, and in Hanna Draw. In Atlantic Rim, testing of Upper Cretaceous-aged coals of the Mesaverde Group began in 2002. Initial wells for the pilot tests have already been tested and, surprisingly, have produced gas from the start. Although the overall success of finding economic methane resources in the Atlantic Rim area is still unknown, recent exploratory activity suggests that gas production from coal reservoirs will be successful at least in some portions of the area. Exploration is active along the crest of the Wamsutter Arch between the Great Divide and Washakie Basins and on the east flank of the Washakie Basin (between Townships 13 and 20 north, and Ranges 89 and 92 west). In the vicinity of Seminoe Road, initial wells for the pilot tests have already been drilled west of Seminoe Reservoir in coals of the Mesaverde Group. In Hanna Draw, the coal tested is in the Tertiary-aged Hanna Formation. Testing was terminated in April 2002 to reevaluate the economics of the project. However, interest in the project has recently revived, and drilling may occur to the north of the last project area.

An ongoing issue is how produced water from coalbeds (as well as other formations) should be disposed of. Options considered include dumping the water in drainages that do not contact the Colorado River system, treating the produced water to adjust its chemical ratios, and injecting the water into formations that contain water of poorer quality. Despite these concerns, there is sufficient confidence in the coalbed reservoirs' economic viability for major proposals to have been made. These proposals currently are being evaluated by means of EISs (for example, an EIS is being prepared for the collective proposals in Atlantic Rim).

The large structures in the central portion of the RMPPA may have applicability for CO₂ sequestration. This is a positive environmental factor, with disposal of the greenhouse gas. In the case of productive structures, CO₂ sequestration could increase oil recovery. Coal is also known to allow CO₂ sequestration and to have the added benefit of enhancing coalbed natural gas recovery because the coal preferentially replaces methane from the coal structure with CO₂. Studies show that low-rank coals have the highest replacement factor. CO₂ is readily available from large reserves to the west of the RMPPA, and a CO₂ pipeline is already in place.

Coal

There are six identified coalfields within the RMPPA. Of these, the Hanna Field has been the most significant in terms of both historic and projected coal production. Most activity within the remaining fields typically has been of small scale, and in some cases the coal resource has yet to be economically exploited. Approximately 27 million tons of federal coal have been recovered using strip mining. An additional 16 million tons of federal coal have been extracted using underground mining methods.

Recently, there has been a contraction of the coal sector within the Hanna Field. As of 1979, five mining companies were still active in the Hanna Field (Glass and Roberts 1979), but by the year 2000 there were only three active coal mines (two surface mines and one underground mine). Two companies operated these mines. As of mid-2002, only one company, Arch of Wyoming, Inc. (a subsidiary of Arch Western Resources, LLC), was still active. This company operated the Seminoe No. II Mine (a combination dragline and shovel/truck operation) and the Medicine Bow Mine. Remaining economic/strippable reserves in both mines have been indicated as sufficient to sustain operations for fewer than 2 years. As of 2004, all coal mining had ceased, and only reclamation activities currently occur.

Coal is classified by rank in accordance with standard specifications of the American Society for Testing and Materials (ASTM). ASTM D-388 provides detailed information concerning coal classification specifications and considerations. Within the RMPPA, there are six significant coalfields containing coal resources of sub-bituminous to bituminous rank (Berryhill et al. 1950): Hanna Basin, Carbon Basin, Great Divide Basin, Rock Creek, Kindt Basin, and Little Snake River.

Locatable Minerals

Wyoming is a uranium province. Uranium was discovered in the Powder River and Wind River Basins during the 1950s, and continued exploration for uranium resulted in discovery of additional sedimentary uranium deposits in the major basins of central and southern Wyoming. The RMPPA contains its share of sedimentary uranium deposits in the Shirley Basin, the Great Divide Basin, the Red Desert area, and around Baggs in the Poison Buttes area. In addition to uranium, the RMPPA contains deposits of titaniferous magnetite, stratabound gold, copper-gold deposits, and diamonds hosted in kimberlite pipes. Commercial development of the sedimentary uranium and titaniferous magnetite deposits has occurred over the past 50 years. The other locatable mineral deposits have seen only limited production and sporadic exploration. Locatable mineral deposits in the RMPPA are summarized in Table 3-6 and shown on Map 3-6.

Table 3-6. Known Locatable Mineral Deposits in the RMPPA

Commodity	Location	Geologic Description	Deposit Type	Production History	Future Potential
Sedimentary Uranium					
Shirley Basin Deposits	T27-28N, R77-80W Shirley Basin 30 x 60	Sandstone uranium deposits hosted in the Tertiary Wind River Formation.	Epigenetic redox/roll front uranium deposits.	Major mines: Petrotomics, Pathfinder, Jenkins. Est. production about 10 to 20 million pounds of U ₃ O ₈ .	Major district with considerable future potential for uranium. Estimated resource of 50 million pounds.
Red Desert Deposits	T18-21N, R99-101W Red Desert 30 x 60 T24N, R93W	Lignite coal uranium. Low-grade uranium mineralization in lignite beds of the Wasatch and Green River Formations. Roll type uranium deposits formed by flow of ore bearing solutions through the host rock.	Disseminated uranium in lignite beds. Grades range from 0.003 to 0.007 percent U ₃ O ₈ . Roll type uranium deposits.	No production of uranium. Estimated resources are 24,000 tons of uranium in coal. Coal estimated at 20 percent strippable. 1,307,529 pounds of uranium. Produced from 1978 thru 1983. No production from 1983 to present.	Grades too low for future production except as byproduct of lignite coal production. Development possible using in-situ methods at current uranium prices.
Great Divide Basin	T24-26N, R93096W Red Desert 30 x 60	Sandstone and evaporative uranium prospects hosted in Tertiary Battle Spring and Bridger Formations.	Epigenetic redox/roll front uranium deposits. Also, evaporative uranium deposits near Lost Creek Mine.	Lost Creek Schroeckinite Deposit (T26N, R94W). Grades are 0.013 to about 0.28 percent U ₃ O ₈ .	Limited future potential. No major deposits.
Poison Buttes (Baggs)	T12-13N, R92W Baggs area Saratoga 30 x 60	Sandstone uranium deposits hosted in Tertiary Browns Park Formation.	Disseminated and epigenetic redox/roll front uranium deposits.	Urangesellschaft proposed mine at 2,000 tpd production.	Considerable future potential at higher uranium prices. Estimated resource of 8 to 15 million pounds.
Ketchum Buttes	T15N, R89W Northeast of Encampment Saratoga 30 x 60	Sandstone uranium prospects hosted in Tertiary Browns Park Formation.	Disseminated and epigenetic redox/roll front uranium deposits.	Prospects only.	
Desert Rose area (USGS PP 538) (USGS MR-21)	T13N, R76W Southwest of Laramie Laramie 30 x 60	Sandstone uranium prospects hosted in Cretaceous Cloverly Formation.	Disseminated and epigenetic redox/roll front uranium deposits.	Prospects only.	
Miller Hill area	T18N, R88W Rawlins 30 x 60	Sandstone uranium prospects hosted in Tertiary Browns Park Formation.	Disseminated and epigenetic redox/roll front uranium deposits.	Prospects only.	

Commodity	Location	Geologic Description	Deposit Type	Production History	Future Potential
Encampment/Riverside	T15-16N, R84-85W Saratoga 30 x 60	Sandstone uranium prospects hosted in Tertiary Browns Park Formation.	Disseminated and epigenetic redox/roll front uranium deposits.	Prospects only.	
Magmatic Uranium					
Pedro Hills	T26N, R81W West side of Shirley Basin Shirley Basin 30 x 60	Veins in Precambrian rocks.	Magmatic-hydrothermal uranium veins along fissures.	Little Man Mine—No production history.	Limited future potential. This type of deposit is difficult to develop.
Titaniferous Magnetite					
Iron Mountain District	T18-19N, R71W Rock River 30 x 60	Lenses, masses, and beds of titaniferous magnetite and ilmenite with spinel in Precambrian Laramie Anorthosite.	Magmatic segregations and/or possible replacements within layered mass of feldspar and olivine called Laramie Anorthosite. Deposits follow anticlinal axis of anorthosite.	Main mines are Shanton, Iron Mountain, and Sybille Pit. Past production was about 1.1 million tons to 1968. Past operators were Union Pacific Railroad and Anaconda.	Estimated 30 million tons of massive ore at 45% Fe and 20% TiO ₂ . Disseminated ore estimated at 148 million tons at 20% Fe and 9.7% TiO ₂ .
Sheep Mountain	T15N, R77W Medicine Bow 30 x 60	Titaniferous magnetite black sand deposit in the Mesaverde Formation.	Paleo-beach sand deposit 4,300 feet long and about 50 feet by 17 feet. Grades are 15.6% TiO ₂ . No identified resource.	No production.	Uncertain.
Rare Earths and Yttrium, Including Columbite and Tantalite					
Big Creek District	T13N, R81-82W Saratoga 30 x 60	Veins and pegmatites in Precambrian granite intrusives.	Hydrothermal veins and pegmatites in granites.	Prospects only.	
Tie Siding Area	T12N, R71-72W Laramie 30 x 60	Pegmatites in Sherman granite.	Radioactive pegmatites.	Prospects only.	
Red Mountain Syenite	T22N, R71W Laramie 30 x 60	Disseminated allanite in Precambrian syenite intrusive mass.	Disseminated rare earth element (REE) deposit.	No production.	
Fox Creek Pegmatites	T13N, R78W Laramie 30 x 60	Pegmatites with columbite and tantalite.	High-grade pegmatites.	Past production of 85 pounds of columbite and tantalite.	

Commodity	Location	Geologic Description	Deposit Type	Production History	Future Potential
Stratabound Gold					
Ferris Mountains	T27N, R87-88W Bairoil 30 x 60	Vein-like deposits and beds in Precambrian metasediments and granites.	Exhalative iron-formation gold and copper deposits and associated intrusives with veins. Gold and copper associated with jasperoid beds.	Spanish Trail Mine. No recorded past production.	Deposit type known to host major gold deposits worldwide.
Seminole Mountains	T25-26N, R84-86W Bairoil 30 x 60	Vein-like deposits and beds in Precambrian metasediments and granites.	Exhalative iron-formation gold and copper deposits and associated intrusives with veins. Gold and copper associated with jasperoid beds in hornblende schist.	Penn Mine at Bradley Peak. Three adits with limited production. Estimated past production of 530 oz Au.	Estimated 100 million tons of Fe ore at 28% to 68% Fe. Gold values to 2.7 opt Au. Nephrite jade present in Seminole area.
Copper-Gold Deposits					
Jelm Mountain District	T12-13N, R76-77W Laramie 30 x 60 Saratoga 30 x 60	Copper-gold-silver-arsenic-bismuth "veins" in Precambrian amphibolite schist.	Oxidized quartz veins and mineralized shears in Precambrian metasediments and associated with mineralized pegmatites.	Annie Mine has 3% to 30% Cu and 0.1 opt Au. Wyoming Queen has three shafts to depths of 250 feet. No data on past production histories.	Deposits similar to major gold deposits of Canada. Veins may be folded beds, as they are in Canada.
Cooper Hill District	T18N, R78W Medicine Bow 30 x 60	Copper and gold veins in Precambrian schist.	Vein and shear-zone sulfide mineralization in folded Precambrian schists.	Charlie, Emma G, and Albion Mines. Grades to 0.7 opt Au and 12.2 opt Ag. No recorded production history.	Deposits similar to major gold deposits of Canada. Veins may be folded beds, as they are in Canada.
Silver Crown District	T13-14N, R69-70W Laramie 30 x 60	Precambrian quartz monzonite intrusive related to Nash Fork– Mullen Creek Shear Zone.	Disseminated copper and gold deposit related to Precambrian island-arc volcanism and intrusive igneous rocks.	Copper King Deposit: 35 million tons at 0.2% copper and 0.02 opt gold.	Copper King is only drilled reserve in area. May become economic at higher copper and gold prices.
Kimberlite/Diamonds					
Iron Mountain District	T19-20N, R70W Rock River 30 x 60	Devonian kimberlite intrusives into Precambrian Laramie Anorthosite.	Kimberlite pipes with diamonds.	No production history.	Diamonds small and mainly of industrial quality.
Stateline District	T12N, R72W Laramie 30 x 60	Devonian kimberlite intrusives into Precambrian granites and metamorphics.	Kimberlite pipes with diamonds.	No past production. Diamond grades in range of 0.5 to 1.0 carat/100 tonnes. Industrial grade diamonds.	Diamonds small and mainly of industrial quality. Potential for more discoveries considered high.

Source: BLM 2003.

Common Variety Minerals

Disposal of common variety minerals is discretionary and is addressed under the Materials Act of 1947, as amended by the Acts of 1955 and 1962. These acts authorized that certain mineral materials be disposed of either through a contract of sale or a free use permit (for state and local governments or eligible nonprofit organizations). The group of mineral materials commonly known as “common variety minerals” includes common varieties of sand, stone, gravel, pumice, cinders, clay, and petrified wood in public lands of the United States (Maley 1977). Common variety minerals that occur within the RMPPA include sand and gravel, limestone, granite, moss rock, cinders (clinker), clay, and petrified wood.

By far the most significant common variety minerals within the RMPPA include sand and gravel, limestone, clinker (scoria), and thin-layered building stone known as moss rock. Sand and gravel resources typically occur in one or more of the following forms: gravel deposits, alluvial sand and gravel deposits, terrace sand and gravel deposits, glacial gravels, older gravel deposits, and windblown deposits. Limestone typically occurs in bedded sedimentary deposits. Within the RMPPA, the aggregates resource base is generally present as windblown, terrace, and alluvial deposits; however, coarser, gravel-type materials are present to a somewhat lesser degree. Where gravel is present, it is generally an older gravel (conglomeratic) deposit, often situated beneath surficial deposits. The Wyoming Geologic Survey has identified aggregate deposits in the RMPPA near Fort Steele (T21N, R85W), Elmo (T22-23N, R81W), and Creston Junction (T21N, R92W) and in the Red Desert Basin (T21-23N, R95-97W).

3.8.5 Site Reclamation

A reclamation plan will be developed to provide a framework for project- and site-specific reclamation actions. The plan will involve coordination between the project proponent and BLM in order to produce a comprehensive plan. Reclamation goals will emphasize ecosystem reconstruction that returns the land to a condition equal to or better than that which existed before disturbance occurred. Interim reclamation goals are intended to initiate or accelerate the recovery of the ecosystem including rapid stabilization of disturbed areas to protect disturbed and adjacent undisturbed areas from unnecessary degradation. Interim reclamation measures are intended to achieve this short-term goal while setting the stage for final recovery. Final reclamation measures are used to achieve complete recovery of the disturbed ecosystem such that it continues its development, does not require further assistance or treatments, and demonstrates resilience to normal ranges of environmental stress and disturbance.

3.9 OFF-HIGHWAY VEHICLES

Off-highway vehicle (OHV) use is closely related to several environmental resource issues addressed in other sections of this chapter. Aspects of OHV use that are specifically addressed in other sections of this document, such as Recreation (Section 3.11) and Transportation and Access (Section 3.14), will not be addressed in this section. All information in this section was gathered from the Recreation Planner for the RMPPA and from BLM sources, which included the Great Divide Resource Area RMP and BLM's Recreation Management Information System (RMIS) (Clair 2002a, 2003, and 2004; BLM 1990a; BLM 2003a).

3.9.1 Designated Off-Highway Vehicle Use Areas

OHV use is managed according to designations finalized in the Great Divide Resource Area RMP. These designations prescribe the available management environment in which OHV users can travel. Potential OHV designations are open, closed, or limited (Appendix 21). With the exceptions listed below, the RMPPA is open to the use of motorized OHV use. In addition, the RMP prescribes that OHV use throughout the RMPPA be limited to existing roads and vehicle routes, except in six specified areas that contain different designations. These six areas and their OHV use classifications are as follows (Map 2-5):

- **Dune Ponds Cooperative Management Area.** The Dune Ponds CMA is an “open” OHV use area, except in vegetated areas, which are restricted to existing roads and vehicle routes.
- **Adobe Town WSA.** In this area, located in the southwest corner of the RMPPA, motorized vehicle use is limited to designated roads and vehicle routes.
- **Encampment River Canyon.** Located just north of the Medicine Bow National Forest and south of State Highway 70 near the town of Encampment, this area is closed to motorized vehicle use, including over-the-snow vehicles, from December 1 to April 30.
- **Encampment River Trail.** Bisecting the Encampment River Canyon area referred to above, the portions of the Encampment River Trail that cross BLM-administered public land are closed to all types of motorized vehicle use year-round.
- **Ferris Mountains WSA.** Located near the northern boundary of the RMPPA and southeast of the intersection of U.S. Highway 287 and State Highway 220, this area is closed to all types of motorized vehicle use year-round.
- **Pennock Mountains Wildlife Habitat Area.** Located east of Saratoga, Wyoming, this area is closed to all human presence and motorized vehicle use, including over-the-snow vehicles, from November 15 through April 30.

3.9.2 Off-Highway Vehicle Use and Trends

OHVs are used for a variety of purposes. In the RMIS, OHVs are separated into four categories: all-terrain vehicles (ATV), cars/trucks/sport utility vehicles (SUV), motorcycles, and snowmobiles. Snowmobile use, although technically considered OHV use, was not included in the OHV categories in RMIS but will be addressed in this section. Table 3-7 shows the estimated number of participants and visitor days associated with OHV use in the RMPPA.

Table 3-7. Participants and Visitor Days Associated with OHV Use in the RMPPA

OHV Use: Participants and Visitor Days, RFO¹						
Activity	Fiscal Year 2001		Fiscal Year 2002		Fiscal Year 2003	
	Number of Participants	Number of Visitor Days	Number of Participants	Number of Visitor Days	Number of Participants	Number of Visitor Days
OHV—ATV	4,800	1,600	5,000	1,667	5,132	1,711
OHV—Cars/Trucks/SUVs	33,984	16,838	35,134	17,457	36,156	17,908
Snowmobiling	1,200	600	1,250	625	1,283	642

Source: BLM Recreation Management Information System, RMPPA.

The most commonly used of the four OHV categories in the RMPPA is the cars/trucks/SUVs category. ATV use is rapidly growing in popularity. Cars/trucks/SUVs are used by more than 80 percent of OHV participants, and nearly 85 percent of visitor days include car/truck/SUV use.

Within the RMPPA, OHV use provides access to hunting, fishing, and camping. In addition, OHV use is increasingly regarded as a method of recreation in itself. OHV use, although recorded by RMIS, extends beyond recreational use. Gathering of noncommercial products includes activities such as the collecting of shed deer and elk antlers, moss rock, and native plant material. OHVs provide access to large areas of land and easy access to antlers on the ground. Recreationists also commonly use OHVs.

Employees of authorized users, such as government agencies, ranches, oil and gas companies, and utility providers, use OHVs to access and maintain the developments that are integral to the continued operation of their facilities. Oil and gas interests through Onshore Order Number 1 can access their leases without a permit but are strongly encouraged to confer with BLM. BLM staff also use OHVs for tasks such as range inspections, surveying and mapping, inventories, monitoring, vegetation treatments, fire suppression, project maintenance, and construction.

OHV designations in the RMPPA for the majority of public lands are “limited to existing roads and vehicle routes.” However, the number of unauthorized roads pioneered within the RMPPA is expanding rapidly. Even authorized activities can lead to unauthorized roads and vehicle routes. A concern is that, in all of the above uses, OHV users often leave existing roads and vehicle routes and create new two-tracks, thereby contributing to vegetation loss, soil compaction, soil erosion, and wildlife harassment. In addition, use of existing roads and vehicle routes when they are muddy causes rutting and erosion whether the roads/vehicle routes are two-tracks or improved, and such use creates public safety hazards to drivers that follow. Within the RMPPA, OHV use in the Sand Hills and Dune Ponds areas is of special concern because of the fragile nature of these areas. The Dune Ponds area receives a number of visitors because of its proximity to the Seminole Reservoir and the population center of Rawlins.

Over the past 25 years, ownership of OHVs has become commonplace. A lack of understanding of land use ethics has increased inappropriate uses of OHVs on federal lands. Shortage of law enforcement personnel and a rapid increase in OHV use throughout the RMPPA make it difficult to enforce OHV designations. This situation generally occurs more often in areas of higher recreational use, but there is evidence of rapid route proliferation throughout the RMPPA.

3.10 PALEONTOLOGY

The Draft Wyoming Paleontology Manual issued by the Wyoming BLM State Office presents guidelines used to ensure that BLM in Wyoming meets its statutory obligations for protection of paleontological resources. The following sections present an overview of the paleontological resources present in the RMPPA, along with the associated paleontological classifications.

3.10.1 Description of Resources

Some of the richest paleontological resources in the United States are in the RMPPA. Vertebrate fossils are especially significant in the area. Paleontological research has been conducted in this part of Wyoming since 1856. More than 30 museums and universities have searched the area for vertebrate fossils, and fossils recovered from the RMPPA can be found in public and private collections around the world (USDI, BLM 1987).

The rich paleontological resources present in the RMPPA can be attributed to the area's high elevation and continental climate, which hinder vegetative growth and soil development and support erosion and bedrock exposure. Most fossils are discovered as scattered finds in areas of exposed rocks. Paleontologists frequently rely on the public-at-large who often play a major role in making significant fossil discoveries.

Exposures that produce significant fossils, particularly vertebrates, are rare, and consequently the fossils are of considerable scientific value and interest wherever they are found. Some localities in the RMPPA have yielded the only fossil record of several extinct animals (USDI, BLM 1987).

An important paleontological resource in the RMPPA is the Como Bluff National Natural Landmark (NNL) area, which encompasses 7,680 acres located about 5 miles east of Medicine Bow. Como Bluff is a westward-plunging anticline containing formations from the Triassic through the Cretaceous periods exposed in the face of the bluff. The dinosaur graveyard fossil bed, an uncommon concentration of well-preserved fossils in the Jurassic Morrison Formation, is exposed in the Como Bluff area. The fossils found in the Como Bluff area played a significant historic role in the development of paleontology as a scientific discipline (USDI, BLM 1987).

Within the Sand Creek NNL, late Pleistocene and more recent vertebrate fossil deposits were recovered within a feature known as the "animal trap." This NNL is located about 20 miles southwest of Laramie and includes 4,800 acres, of which BLM administers a 160-acre parcel of public land. Fossil deposits recovered from the animal trap include a large extinct lion, an eagle-like vulture, and a marten as well as other species no longer found in the area (USDI, BLM 1987).

The Washakie Basin, a large physiographic feature with an area of 525 square miles, is located in the southwestern corner of the RMPPA. Characterized as an intermontane desert basin, the Washakie Basin contains important paleontological resources. Fossils are present in abundance, and many institutions have actively studied the paleontology of the area (USDI, BLM 1987).

The area in and around the Continental Divide contains one of the most complete records of continental deposition in North America, with exposures of the Fort Union, Battle Springs, Wasatch, Green River, and Washakie Formations. The Washakie Formation contains fossils of algae, mollusks, and mammals. Well-preserved fossil fish are contained in the Laney Member of the Green River Formation. Within the Wasatch Formation, vertebrate fossils are found primarily in the non-red facies of the variegated beds, including sandstones. Plant and animal fossils have been found throughout the Fort Union Formation (USDI, BLM 1999).

The Medicine Bow Formation, which underlies a portion of the RMPPA, is known to produce vertebrate fossils of scientific significance. Fossils from the Medicine Bow Formation include the remains of marine

and freshwater invertebrates, terrestrial plants, and terrestrial vertebrates. Microfossils (pollen) and megafossils (leaf and stem imprints, and petrified and carbonized wood) have been found in the formation. Invertebrate fossils include marine foraminifers and brackish-water gastropods and bivalves. The formation has also produced dinosaur bone fragments from the ceratopsian Triceratops and the remains of a small number of mammals from the late Cretaceous Period (USDI, BLM 2001).

The Ferris and Medicine Bow Formations within the RMPPA produce fossils of particular significance because they preserve strata containing the Cretaceous-Tertiary boundary that dates to the time of the extinction of the dinosaurs and adaptive radiation of mammals. The Ferris Formation has produced the remains of early Paleocene mammals as well as fossil leaves and shells of freshwater invertebrates and trace fossils. The Hanna Formation has produced the remains of terrestrial and aquatic vertebrates, invertebrates, and plants of the Paleocene to possibly earliest Eocene age. These fossils are significant because the Paleocene-Eocene boundary dates to the transition from Archaic to Modern orders of mammals (USDI, BLM 2002a).

3.10.2 Potential Fossil Yield Classification

BLM has classified geologic formations in the RMPPA according to the Potential Fossil Yield Classification (PFYC). This is a planning tool whereby geologic units, usually at the formation or member level, are classified according to the probability of yielding paleontological resources that are of concern to land managers. Existing statutes and policies regulate the collection and disposition of vertebrate fossils, but not invertebrate fossils except in special circumstances. This classification is based largely on how likely a geologic unit is to produce vertebrate fossils. Table 3-8 describes these classes, with some examples of corresponding management considerations or actions.

Appendix 30 lists geologic formation classifications, according to the PFYC, for the State of Wyoming. The classifications of paleontological resources determine the procedures to be followed before a paleontological clearance to proceed with a project can be granted. There are more than 1,270,000 acres of PFYC Class 4 within the RMPPA. Assigning a formation to Class 5 is determined during site-specific analysis of Class 4 areas. Site-specific conditions may reduce the need for a Class 5 formation to require intense mitigation. In the RMPPA, there are around 240,000 acres of PFYC Class 1, more than 550,000 acres of PFYC Class 2, and more than 1,480,000 acres of PFYC Class 3.

To manage the collection of scientifically significant fossils, BLM requires that a paleontological collecting permit be obtained for collection of vertebrate fossils and scientifically significant invertebrate fossils. These permits are issued only to qualified paleontologists.

Table 3-8. 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. Landslides and glacial deposits.	The land manager's concern for paleontological resources on Class 1 acres is negligible. Ground disturbing activities will not require mitigation except in rare circumstances.
2	Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant invertebrate fossils.	Vertebrate fossils known to occur very rarely or not at all. Age greater than Devonian. Age younger than 10,000 years before present. Deep marine origin. Aeolian origin. Diagenetic alteration.	The land manager's concern for paleontological resources on Class 2 acres is low. Ground disturbing activities are not likely to require mitigation.

Class	Description	Basis	Comments
3	Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Also sedimentary units of unknown fossil potential.	<p>Units with sporadic known occurrences of vertebrate fossils.</p> <p>Vertebrate fossils and significant invertebrate fossils known to occur inconsistently; predictability known to be low.</p> <p>Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.</p>	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.
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.	<p>Significant soil/vegetative cover; outcrop is not likely to be impacted.</p> <p>Areas of any exposed outcrop are smaller than 2 contiguous acres.</p> <p>Outcrop forms cliffs of sufficient height and slope that most is out of reach by normal means.</p> <p>Other characteristics that lower the vulnerability of both known and unidentified fossil localities.</p>	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 impact the paleontological resources. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.
5	Highly fossiliferous geologic units that regularly and predictably produce invertebrate fossils and/or scientifically significant invertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts.	<p>Vertebrate fossils and/or scientifically significant invertebrate fossils are known and documented to occur consistently, predictably, and/or abundantly.</p> <p>Unit is exposed; little or no soil/vegetative cover.</p> <p>Outcrop areas are extensive; discontinuous areas are larger than 2 contiguous acres.</p> <p>Outcrop erodes readily; may form badlands.</p> <p>Easy access to extensive outcrop in remote areas.</p> <p>Other characteristics that increase the sensitivity of both known and unidentified fossil localities.</p>	The land manager's highest concern for paleontological resources should focus on Class 5 acres. 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.

3.11 RECREATION AND VISITOR SERVICES

Recreation is one of the major resource uses within the RMPPA. The term “recreation” includes a variety of activities that affect and are affected by resources and other resource uses. This section addresses the existing recreational environment within the RMPPA, describing the recreation resources, the levels of use of these resources, and use trends. This section also addresses threats to recreation resources within the RMPPA. All information in this section was gathered from the Recreation Planner for the RMPPA and from BLM sources, which included the Great Divide Resource Area RMP and BLM’s RMIS (Clair 2002a, 2003, and 2004; BLM 1990a; BLM 2003a).

3.11.1 Recreation Resources

Recreation resources include recreation sites and dispersed public lands, wildlife resources, visual resources, waterways, lakes, and other resources (physical, historical, etc.), each of which provides different recreational opportunities.

The RMPPA offers a wide variety of recreational opportunities, primarily for dispersed use requiring undeveloped open space. These activities include wildlife viewing, hunting, hiking, backpacking, OHV use, fishing, bicycling, photography, camping, orienteering, and floating. For a physical description of the resources, see the geology, Forest Management, range, wildlife, and vegetation sections of this chapter.

Based on the Recreation Opportunity Spectrum (ROS) classification system, WSAs in the RMPPA are managed as primitive and suited to activities requiring solitude, self-reliance, and an unmodified, natural environment.

A large portion of the RMPPA is managed as Middle Country, which is greater than 1/2 mile from improved roads and in which the landscape appears to be natural, except for obvious primitive roads. The second most abundant class is Front Country, where improved roads are within 1/2 mile. Front Country is the predominant class in areas developed for oil and gas due to the prevalence of improved roads, particularly in the western area of the RMPPA. Lands within 1/2 mile of highways and lands dominated by agriculture or industrialization are designated as rural. The small acreage in proximity to and including towns or cities are classified as urban.

Recreation Sites and Areas

In areas where recreation resources receive heavy use, developed recreation sites are often constructed to aid in managing impacts. Consequently, developed recreation sites are primarily located near high-use recreation attractions. There are 11 developed recreation sites, 7 undeveloped recreation sites, and 7 recreation areas within the RMPPA. These sites (Map 3-7) are as follows:

- Developed Recreation Sites
 - Rim Lake Recreation Site
 - Teton Reservoir Recreation Site
 - Encampment River Campground (fee site)
 - Bennett Peak Recreation Site (fee site)
 - Corral Creek Campground
 - Dugway Recreation Site
 - Prior Flat Campground
 - Lake Hattie Reservoir
 - Twin Buttes Lake
 - Wheatland Reservoir #3
 - East Allen Lake
- Undeveloped Recreation Sites

- Nine-Mile Hill
- Big Creek
- Shirley Basin Reservoir
- Little Sage Reservoir
- Little Robber Reservoir
- Laramie River Access.

In addition to these recreation sites, there are larger dispersed areas that receive heavy recreational use.

These areas (Map 3-7) are as follows:

Jelm Mountain Area

The Jelm Mountain area provides diverse recreation opportunities associated with Jelm Mountain. This area is popular with recreationists from the Laramie area. Existing recreational uses include hunting, camping, fishing, wildlife viewing, OHV touring, and other compatible uses. The University of Wyoming's 2.3-meter telescope is located at the Wyoming Infrared Observatory (WIRO) on the summit of Jelm Mt. This site was chosen because of: (1) the dryness of the air, which is an important consideration for infrared astronomy, since moisture strongly absorbs infrared radiation; (2) the comparatively low turbulence in the air above the mountain; (3) a dark night sky; (4) close proximity to the University of Wyoming; and (5) pre-existing roads, electricity and phone lines since Jelm was formerly used by the USFS and BLM as a fire lookout station. The planning for WIRO began in the early 1970s. WIRO became operational in September of 1977 and still ranks as one of the premier infrared observatories in the world.

Pedro Mountains Area

The Pedro Mountains area is a popular area for rock climbing and other non-motorized recreational activities. Other existing uses include hunting, backpacking, camping, wildlife viewing, and hiking.

Laramie Plains Lakes Area

The Laramie Plains Lakes area, including Lake Hattie Reservoir and Twin Buttes Lake, provides water-related recreation opportunities for fishing, camping, wildlife viewing, and boating in concert with multiple uses such as grazing and wildlife and fisheries habitat.

Rawlins Fishing Areas

Teton Reservoir and Rim Lake Recreation Sites provide water-related recreation opportunities for fishing, camping, wildlife viewing, and boating in concert with compatible multiple uses. Teton Reservoir Recreation Site provides for good fishing access and is popular for its fishing. Rim Lake Recreation Site is located near and is a popular access point to the Continental Divide National Scenic Trail.

The remaining three areas, like recreation sites and dispersed recreation areas, are designated as Special Recreation Management Areas (SRMA) to acknowledge the importance of their recreation resources and to help manage these resources in a way that allows continued, increasing levels of use without damage to the resources. There are three existing SRMAs in the RMPPA: the Shirley Mountain SRMA, the North Platte River SRMA, and a portion of the Continental Divide National Scenic Trail that passes through the BLM-administered land (Map 2-46). The existing recreational environment of these areas is discussed in the following section.

3.11.2 Special Recreation Management Areas

SRMAs are managed for significant or unique recreational resources and to maintain or enhance a diversity of recreational opportunities and benefits (Table 2-11). Currently there are three such areas within the RMPPA: the Continental Divide National Scenic Trail SRMA, the North Platte River SRMA, and the Shirley Mountain SRMA (Map 2-14). Table 3-9 summarizes RMIS data for these areas over the past 3 fiscal years (FY01–03). In addition to the presentation of these data, each area is summarized briefly below.

Table 3-9. Recreational Management System Information for Special Recreation Management Areas Within the RMPPA

Number of Recorded Participants and Visitor Days ¹ October 1, 2000–September 30, 2003						
Activity	Continental Divide National Scenic Trail SRMA		North Platte River SRMA		Shirley Mountain SRMA	
	Number of Participants	Number of Visitor Days	Number of Participants	Number of Visitor Days	Number of Participants	Number of Visitor Days
Backpacking	106	1,421	NA	NA	NA	NA
Bicycling—Mountain	17	8	NA	NA	NA	NA
Camping	80	105	6,472	14,102	603	2,411
Canoeing/Kayaking	NA	NA	195	129	NA	NA
Fishing	NA	NA	50,828	18,295	NA	NA
Hiking/Walking/Running	NA	NA	5,149	1,687	NA	NA
Hunting—Big Game	16	11	4,025	6,089	6,028	12,054
Hunting—Waterfowl	NA	NA	1,662	1,107	NA	NA
Nature Study	NA	NA	889	74	NA	NA
OHV—Cars/Trucks/SUVs	41	27	1,059	89	10,849	5,454
Picnicking	80	6	14,391	1,200	1,205	51
Row/Float/Raft	NA	NA	19,509	6,544	NA	NA
Viewing—Wildlife	NA	NA	38,259	5,266	10,849	1,808

Source: BLM Recreation Management Information System, BLM RMPPA.

¹ Some activities listed occur within the SRMAs but are not recorded.

Continental Divide National Scenic Trail SRMA

The currently designated portions of this SRMA cover about 82 miles of trail primarily on BLM-managed land (plus some state land) in the RMPPA. Its key uses include camping, hiking, mountain biking, and driving in proximity to the Continental Divide from the Canadian to the Mexican border. Although all but a very short portion of the trail follows existing roads and vehicle routes through the RMPPA, due to easement issues across non-federal lands, the exact trail route has not yet been fully identified.

North Platte River SRMA

By far, this SRMA receives the heaviest use of the three existing SRMAs in the RMPPA. It is a 5,060-acre SRMA that follows the North Platte River from the Colorado-Wyoming border to Seminoe Reservoir. Water-related recreational activities draw large numbers of participants. The largest number of participants, just over 50,000, fish the river. Other important activities in this SRMA include floating, picnicking, waterfowl hunting, camping, and wildlife viewing. Bennett Peak is the most heavily used recreation site on the Upper North Platte River for camping, floating, and fishing. Although the Dugway Recreation Site has a small campground, it is most popular with day use fishermen and picnickers.

Shirley Mountain SRMA

The Shirley Mountain SRMA contains 24,440 acres of public land. The SRMA is popular for dispersed recreation, especially hunting during the fall deer, elk, and antelope seasons. Prior Flat Campground is gaining in popularity, particularly with visitors from the Casper area. The campground is heavily used during hunting season. Dispersed camping, OHV use, and wildlife viewing occur throughout the rest of the SRMA as well. The recreational physical, social, and administrative settings in the Shirley Mountain SRMA are managed as a middle country. This setting is influenced by the amount of users who frequent the area for dispersed camping, OHV tours, sight seeing, and hunting. There are numerous two tracks leading to noticeable primitive campsites, private inholdings, and a communication site consisting of two towers. The BLM manages the area as a Limited OHV area; OHVs are limited to designated roads and trails. Additional administrative presence is noticeable at the Prior Flats Campground, a developed campground acting as the gateway into the Shirley Mountains. Back country settings exist in the Shirley Mountain SRMA, located in the forested areas, the remote canyons, and lookouts away from the vehicle routes and campsites.

Cave Creek Cave is located within the SRMA area and contains a hibernaculum for several bat species, including bat species on the BLM sensitive species list. Ground water near Cave Creek provides unique humidity and temperature conditions that support hibernating and breeding bats. Cave Creek Cave's physical characteristics provide for a unique natural recreational resource setting highly suitable for caving. Cave Creek Cave historically has been and remains a popular area for exploring the numerous route networks and caverns.

3.11.3 Wildlife Resources

The wildlife resources (nongame, big game, small game, waterfowl, upland birds, fish, etc.) within the RMPPA provide amazing opportunities for recreational uses. There are several world-class fisheries within the RMPPA in addition to a number of areas that offer prime habitat for several big game species. There are also habitats for a variety of upland game birds. The abundance of wildlife in the RMPPA directly affects the amount and type of recreational uses available. When wildlife populations fluctuate, so do the opportunities for recreation that involve those populations.

Wildlife recreation, such as hunting, fishing, trapping, and wildlife viewing, represents approximately 60 percent of all recreational activities in the RMPPA. In addition, visitor days (1 visitor day represents an aggregate of 12 hours a visitor spends at a site, area, or activity) spent on the above-mentioned activities

make up over 55 percent of all visitor days devoted to recreation. For more information on the existing environment for wildlife, please refer to the discussion in Section 3.19.

3.11.4 Other Resources

Several other resources located within the RMPPA provide additional recreation opportunities. Seminoe Reservoir's recreation resources are managed by Wyoming State Parks, yet several other recreation resources that visitors often use are located close to the reservoir. The Rawlins BLM Field Office has established memorandums of understanding (MOU) with WGFD concerning recreation management on several reservoirs in the Laramie area. MOUs addressing the construction and management of recreation facilities at East Allen Lake, Wheatland Reservoir #3, Twin Buttes Reservoir, and Lake Hattie were entered into between 1973 and 1976 and remain in effect. In addition, rivers throughout the RMPPA provide opportunities for fishing as well as other water-based recreational opportunities including, but not limited to, canoeing, rafting, and drift boating. In relation to commercial recreational use of river resources, the Rawlins BLM Field Office and USFS have established an MOU that allows river outfitters that enter the river on land managed by one agency to leave the river on land managed by the other agency without having to obtain permits from both agencies.

The system of roads throughout the RMPPA provides an opportunity for casual driving, viewing of wildlife and wild horses, and other such activities. However, other than highways and those roads associated with towns, few roads are paved in the RMPPA, and most county roads, oil and gas roads, and a few BLM roads are graveled. The remainder of the transportation system is, for the most part, minimally improved or unimproved and thus well-suited to dispersed recreational activities, such as hunting and OHV use.

The Continental Divide National Scenic Trail traverses high desert on BLM-administered land before entering the national forest to the south. The trail provides opportunities for hiking, backpacking, horseback riding, OHV use, mountain biking, and other trail-related recreational activities.

3.11.5 Recreational Use

RMIS estimates participation in 65 types of recreational activities recorded at BLM-managed sites and areas. Estimates are based on registration records, permit records, observations, and professional judgment. Visitation rates are estimated by numbers of participants as well as visitor days. Participants are the actual number of people who take part in a recreational activity. A visitor day is a common unit of measure of recreation used among federal agencies. As noted above, 1 visitor day represents an aggregate of 12 visitor hours at a site or area. It should be noted that the number of participants and the number of visitors might differ, as one visitor can participate in several recreational activities, thereby being recorded as a participant several times. Table 3-10 shows a summary of the RMIS data for the RMPPA for 2001, 2002, and 2003. Increases or decreases in visitation to some areas may result from drought cycle influences on water levels of reservoirs, rivers, etc.; gas prices; or other influences that impact local tourism. Estimation protocols and technologies to inventory visitor days continue to evolve.

Table 3-10. Recreational Management System Information on Recreation Participants and Visitor Days in the RMPPA

Recreation Participants and Visitor Days, RMPPA ¹						
Activity	Fiscal Year 2001		Fiscal Year 2002		Fiscal Year 2003	
	Number of Participants	Number of Visitor Days	Number of Participants	Number of Visitor Days	Number of Participants	Number of Visitor Days
Backpacking	156	747	156	725	44	589
Bicycling—Mountain	1,334	447	1,376	439	1,290	431
Camping	12,661	31,144	10,465	20,969	7,027	31,862
Canoeing/Kayaking	8	5	175	116	12	8
Driving for Pleasure	24,000	12,000	25,000	12,500	25,660	12,830
Environmental Education	42	56	NA	NA	NA	NA
Fishing—Freshwater	49,279	19,457	47,789	18,313	42,065	16,785
Gathering Noncommercial Products	2,400	800	2,500	833	2,566	855
Hiking/Walking/Running	14,600	5,350	11,347	2,957	4,772	1,424
Horseback Riding	2,770	1,387	4,344	2,133	4,008	1,991
Hunting—Big Game	30,997	59,453	31,404	61,055	31,842	61,742
Hunting—Waterfowl	500	333	500	333	662	441
Nature Study	300	25	279	23	NA	NA
OHV—ATV	4,800	1,600	5,000	1,667	5,132	1,711
OHV—Cars/Trucks/SUVs	33,984	16,838	35,134	17,457	36,156	17,908
Picnicking	11,878	973	11,966	980	11,541	945
Row/Float/Raft	7,180	2,409	6,102	1,869	3,453	2,124
Snowmobiling	1,200	600	1,250	625	1,283	642
Target Practice	3,600	300	3,750	313	3,849	321
Viewing—Wild Horses	NA	NA	NA	NA	56	37
Viewing—Wildlife	86,601	8,100	84,785	7,949	78,425	7,638

Source: BLM Recreation Management Information System, RMPPA.

From October 2000 through September 2003, there were far more dispersed recreation visits and visitor days than there were visits or visitor days at recreation sites (Table 3-11). This is due largely to the popularity of dispersed activities such as hunting, fishing, and OHV use in the RMPPA, and the vast public lands available for these activities.

Table 3-11. Recreation Visits by Location in the RMPPA

Recreation Visits by Location: October 2000–September 2003 Rawlins RMPPA	Visits	Visitor Days
Dispersed Recreation	428,588	369,197
Developed/Undeveloped Recreation Sites	123,224	101,520

Source: BLM Recreation Management Information System, RMPPA.

According to data from fiscal years 2001, 2002, and 2003, dispersed recreation tends to mirror the pattern shown above for the entire RMPPA, with big game hunting, freshwater fishing, wildlife viewing, and OHV cars/trucks/SUVs topping the list of activities. Within these few activities, approximately 250,000 participants viewed wildlife for more than 23,000 visitor days, while approximately 94,000 participants spent more than 182,000 visitor days hunting big game, and approximately 140,000 participants spent more than 54,000 visitor days fishing. Trail activities, such as walking, hiking, and running, were also popular activities at recreation sites. Although dispersed recreation patterns tend to mirror the overall RMPPA recreation patterns, recreation near developed and undeveloped sites will tend to be water-related, with more participants recreating for fewer visitor days.

3.11.6 Recreation Trends

The current trends in recreational use in the RMPPA indicate steady to slight increases. Many of the recreational activities in the RMPPA are directly tied to various natural resources, resulting in a correlation between the condition of the resources and the number of users. The recreation trends tied most directly to resource conditions are those that require wildlife populations to be healthy. These include hunting and fishing recreation trends. In addition, annual precipitation will affect the level of rivers and streams and the recreation that requires these resources, such as fishing and floating. Given favorable conditions for these resources, their recreational use will likely continue to rise slowly.

3.12 SOCIOECONOMICS

The RMPPA encompasses a large area across much of southern Wyoming and is located within four counties: Albany, Carbon, Laramie, and Sweetwater. Because activities in the RMPPA have the potential to affect all of these counties, the socioeconomic study area has been defined as these four counties. Demographic and economic data for the socioeconomic study area have been collected from a variety of sources. A 20-year time horizon was chosen to examine recent trends in demographic and economic parameters for the socioeconomic study area. These trends and parameters are discussed in detail below.

3.12.1 County Characteristics

Like much of Wyoming, the counties within the RMPPA socioeconomic study area are quite rural. Three of the four counties encompass a rather large land area with a dispersed population, as summarized in Table 3-12. Laramie County, the exception, has a higher population density largely as a result of the location of Cheyenne within its borders. The number of persons per square mile ranges from 2.0 in Carbon County to 30.4 in Laramie County.

Table 3-12. Geographic Characteristics of the Study Area

Geographic Characteristic	Albany	Carbon	Laramie	Sweetwater	Wyoming	United States
Land Area (Million Acres)	2.7	5.1	1.7	6.7	62.1	2,200
Land Area (Square Miles)	4,273	7,896	2,686	10,425	97,100	3.5 Million
Persons Per Square Mile	7.5	2.0	30.4	3.6	5.1	79.6

Source: U.S. Census Bureau, Quick Facts, (USCB 2003).

The largest population centers in the socioeconomic study area are listed in Table 3-13. These areas have reported changes in population over the past decade that vary by location. Out of the four counties, only two grew from 2000 to 2005. Laramie County grew the most from 2000 to 2005 at nearly 4.4 percent. Sweetwater also grew slightly by about 1 percent, but Albany and Carbon actually lost population with growth of -3.51 percent and -1.97 percent respectively.

Table 3-13. Population Centers

County	City	Population		
		1990	2000	% Change
Albany	Laramie	26,687	27,204	1.9
Carbon	Rawlins	9,380	8,538	-9.0
	Saratoga	1,969	1,726	-12.3
Laramie	Cheyenne	50,008	53,011	6.0
	Pine Bluffs	1,054	1,153	9.4
Sweetwater	Green River	12,711	11,808	-7.1
	Rock Springs	19,050	18,708	-1.8

Land ownership in the socioeconomic study area is summarized in Figure 3-35. Public lands account for a significant proportion of the land base, with 49 percent of total land area owned and managed by federal agencies, including BLM. The RMPPA comprises approximately 3.5 million surface acres, which is 22

percent of the socioeconomic study area. In addition, the RFO staff are responsible for 4.67 million acres of BLM-administered federal mineral estate.

The RMPPA is known for the checkerboard pattern of land ownership covering a large portion of its area. Figure 3-36 summarizes the land ownership within the RMPPA boundaries and shows that BLM manages 32 percent of the total land area, whereas 52 percent is held in private ownership. This land ownership pattern presents challenges in managing resources.

3.12.2 Demographic Characteristics

Population

Annual population estimates for each of the four counties in the socioeconomic study area for 1900 to July 1, 2005 are plotted in Figure 3-37. Population increased by 6 percent over these 15 years, equating to an annual average increase of less than 0.5 percent. Although total population in the socioeconomic study area grew modestly over the past 15 years, examination of the components of population growth yields some additional insights. In Table 3-14, the components of population change show that although there are increases in population in this area due to natural changes (more births than deaths), with the exception of Laramie County, net migration drew individuals away from the area from 2000 to 2005. The socioeconomic study area showed an increase in population from 2000 to 2005. However, the percentage increase was only about half the statewide increase for this same time frame, and the net migration was positive in only Laramie County and statewide. Combined, the four counties experienced decreases in population due to net migration in the 1980s, the 1990s, and from 2000 to 2005, but the decline due to net migration fell from 13.83 percent in the 1980s to only 1.7 percent from 2000 to 2005.

Distribution of the population by ethnicity for 2000 in the socioeconomic study area and in the State of Wyoming is summarized in Figure 3-38. When compared with the state, the socioeconomic study area reported a lower percentage of whites and a slightly higher percentage of individuals indicating they are of Hispanic or Latino descent. The percentage of other ethnic groups is quite small, which is common throughout Wyoming.

Table 3-14. Components of Population Change for the RMPPA

1990–1999										
County	1990 Population	1999 Population	Numeric Change in Population 1990–1999	Percentage Change in Total Population 1990–1999	Cumulative Births	Cumulative Deaths	Natural Change in Population	Natural Percentage Change in Population	Net Migration	Percentage Change in Population Due to Net Migration
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Albany	30,797	29,060	-1,737	-5.64%	3,596	1,487	2,109	6.8%	-3,846	-12.49%
Carbon	16,602	15,437	-1,165	-7.02%	1,715	1,205	510	3.1%	-1,675	-10.09%
Laramie	73,142	78,877	5,735	7.84%	11,110	5,330	5,780	7.9%	-45	-0.06%
Sweetwater	38,823	39,322	499	1.29%	5,245	2,085	3,160	8.1%	-2,661	-6.85%
Study Area	159,364	162,696	3,332	2.09%	21,666	10,107	11,559	7.3%	-8,227	-5.16%
Wyoming	469,557	453,589	-15,968	-3.40%	91,165	32,059	59,106	6.0%	-1,382	-0.30%
1980–1990										
County	1980 Population	1990 Population	Numeric Change in Population 1980–1990	Percentage Change in Total Population 1980–1990	Cumulative Births	Cumulative Deaths	Natural Change in Population	Natural Percentage Change in Population	Net Migration	Percentage Change in Population Due to Net Migration
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Albany	29,062	30,797	1,735	5.97%	4,664	1,526	3,138	10.80%	-1,403	-4.83%
Carbon	21,896	16,659	-5,237	-23.92%	3,589	1,406	2,183	9.97%	-7,420	-33.89%
Laramie	68,649	73,142	4,493	6.54%	13,342	5,064	8,278	12.06%	-3,785	-5.51%
Sweetwater	41,723	38,823	-2,900	-6.95%	8,823	2,022	6,801	16.30%	-9,701	-23.25%
Study Area	161,330	159,421	-1,909	-1.18%	8,253	2,932	5,321	3.30%	-22,309	-13.83%
Wyoming	453,589	479,602	26,013	5.70%	60,099	32,704	27,395	12.60%	-1,382	-16.00%

Source: U.S. Census Bureau.

Personal Income Trends

Personal income data were obtained for each county in the socioeconomic study area from the U.S. Bureau of Economic Analysis (BEA). Figure 3-39 summarizes components of personal income for 1990 through 2000 for the combined economic study area in inflation-adjusted dollars (2001\$). Total personal income increased by over \$1 billion during the 1990s, representing a 28 percent increase. Table 3-15 places these data in perspective by summarizing the estimated poverty rates for the four counties in the socioeconomic study area, for Wyoming, for the West, and for the United States.

Table 3-15. Estimated Poverty Rates for Counties Within the RMPPA

Location	1989	1998
Albany County	19.8%	14%
Carbon County	10.0%	11.8%
Laramie County	10.6%	10.7%
Sweetwater County	8.0%	8.1%
Wyoming	11.9%	11.4%
West	12.5%	14.6%
United States	12.8%	13.3%

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

Personal income can be broken down into three categories: labor income, investment income, and transfer payments. Labor income is derived from wages, salaries, and self-employment income. Investment income is in the form of rents, dividends, and interest earnings. Transfer payments are largely derived from Social Security benefits, Medicare and Medicaid benefits, and other income support and assistance.

Labor income consistently accounts for the greatest percentage of personal income for this area (65 percent in 2000). However, the importance of income from non-labor sources has increased during the 1990s, accounting for 35 percent of total personal income in 2000, up from 31 percent in 1990. This change in how individuals earn income is not unlike national or state trends.

Investment income in the study area grew by 45 percent during the 1990s and accounted for 24 percent of personal income by 2000. Investment income as a percentage of personal income for this area in 2000 was higher than the national average (18 percent) but below the state average (26 percent). The increasing dependence on investment income is common throughout the country given that an increasing percentage of the population is retired.

Transfer payments for the study area grew by nearly 300 percent from 1970 to 2003 and accounted for about 13 percent of total personal income in the study area in 2003. In terms of the relative importance of the various components of transfer payments, government payments to individuals account for 95 percent, and of those payments, retirement and disability insurance benefit payments represent 45 percent and medical payments represent 33 percent. It is interesting to note that in 2003, 52 percent of transfer payments were from age-related sources (retirement, disability, insurance payments, and Medicare), while 7 percent were from welfare. The area's slight increase in dependence on transfer payments as a source of income is very similar to state and national trends, where in 2000 transfer payments accounted for 12 percent of personal income for residents of Wyoming and 13 percent nationally.

The per capita income for the socioeconomic study area has closely followed state and national growth trends associated with per capita income. However, this area has traditionally reported per capita income levels below the national average. For example, in 2000 per capita income for the study area was \$27,660,

which was lower than both the state average (\$28,004) and the national average (\$30,150). To put this in a historical perspective, the per capita personal income depicted in 2004\$ for the study region is illustrated in Figure 3-40 and Figure 3-41. Albany County's per capita income increased from 2000 to 2001 and then showed a steady decline from 2001 through 2004. During this same period, the per capita income in Carbon and Sweetwater Counties went up slightly from 2000 to 2001, fell slightly in 2002, and then increased through 2004. Laramie County's per capita income increased throughout this period.

Per capita income for the study region increased from 2000 to 2001 and then remained relatively flat from 2001 through 2004. During this same time frame, the state of Wyoming's per capita income increased from 2000 to 2001, fell slightly in 2002, and then increased from 2002 to 2004. Throughout this period, the per capita income of Wyoming exceeded the study region's per capita income.

The HUD median family income for the study area from 2000 through 2006 is illustrated in Figure 3-42 and Figure 3-43. The figures show the trend in median family income for all four counties measured in 2004\$ and also for the four-county study region and the state of Wyoming, also measured in 2004\$.

For Albany and Laramie Counties, there was a decline in median family income from 2000 to 2001 and then an increase from 2001 through 2004, followed by a decline in 2005 and an increase in 2006. This same figure indicates a decline in Carbon County from 2000 through 2002, and then a slight increase in 2003 followed by a decline through 2005 and an increase in 2006. Sweetwater County decreased from 2000 to 2001, increased in 2002, declined in 2003, increased in 2004, and fell from 2004 through 2006.

The trend for the four-county region is marked by a decline in 2001 followed by an increase through 2004, a decline in 2005, and an increase in 2006. The trend for the State of Wyoming is the same as for the four-county region. Throughout this period, median family income for the four-county region is greater than the Wyoming median family income.

Even though there was significant oil and gas activity in both Carbon and Sweetwater Counties from 2000 through 2006, the per capita income trend is relatively flat measured in 2004\$. Additionally, both of these counties show a relatively flat to slightly downward trend in median family income over this same time period.

It should be noted that based on the new income by type measure, the four top sectors in 2000 measured in personal income are non-labor income (35.6 percent), services and professional (31.6 percent), and government (23.8 percent). Mining accounted for only 7.6 percent of the total personal income. However, this sectoral distribution of personal income will change as a result of increased oil and gas activity and will likely increase the concentration of economic activity in the oil and gas sector. And to the extent the diversity is reduced, the exposure to a "boom and bust" scenario is enhanced.

3.12.3 Economic Characteristics

This section focuses on trends associated with certain economic characteristics in the socioeconomic study area. These trends include changes in the labor force and unemployment as well as trends in employment and earnings by industry.

Labor Force and Unemployment

Changes in the labor force and in unemployment can provide information on the health of the local economy. The average annual unemployment rates for each of the four study counties and Wyoming are summarized in Figure 3-44. Unemployment in Carbon County has consistently been higher than unemployment for the State of Wyoming from 2000 through 2005. However, unemployment for Albany County has been below the state average over this same time. Examining the study area unemployment reveals that it generally reflects the unemployment rate of the State of Wyoming over this period.

Labor force, employment, unemployment, and unemployment rates are summarized for each county in the study area and for Wyoming in Table 3-16. As mentioned above, overall, the socioeconomic study area mirrored what was occurring in Wyoming during the period extending from 2000 to 2005. However, Carbon County's unemployment rate was higher than the other three counties with the exception of year 2004, when it had the same unemployment rate as did Laramie County.

Table 3-16. Changes in the Civilian Labor Force, 1991–2000

Location	Change in Civilian Labor Force Between 1991–2000	Percentage Change in Civilian Labor Force Between 1991–2000
Albany County	2,516	15.6
Carbon County	-278	-3.2%
Laramie County	5,396	15%
Sweetwater County	-550	-2.7%
Socioeconomic Study Area	7,084	8.7%
Wyoming	32,810	14.0%

Source: U.S. Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics.

Employment and Earnings by Industry

BEA estimates annual employment and earnings for counties throughout the United States. Total annual employment includes both full-time and part-time jobs, so individuals with more than one job will be counted more than once. The employment estimates include persons who are employed by businesses and public entities, as well as individuals who are self-employed. Data were obtained from BEA regarding total annual employment for each of the counties in the economic study area, for Wyoming, and for the United States for 1990 through 2000 to examine trends in employment by industry over the 10-year study period.

Total employment in the economic study area increased by 16 percent during the 1990s, from 94,980 in 1990 to 110,212 in 2000. Compared with employment growth in Wyoming and nationwide, this area showed slower growth in employment. For instance, over the same 10-year period, total employment grew by 21 percent in Wyoming and 20 percent nationwide.

Employment trends in the four-county study area by industry for 1990 through 2000 are summarized in Figure 3-45. The largest employers in the region include government services and trade, which comprised 70 percent of total employment in 2000. But it should be noted that the Regional Economic Information System (REIS) database indicates that mining employment covering the period from 1970 to 2000 in Albany and Laramie Counties fluctuated slightly, and that Albany County showed some slight growth while Laramie County declined during this same time frame. Moreover, Carbon County mining employment grew from 1970 to 1980 and then showed a steady decline from 1981 to 2000.

Figure 3-46 provides a summary of earnings trends by industry for the study area for 1990 through 2000. Earnings from the government sector dominate this area, providing the largest percentage of earnings of any industry and consistently accounting for nearly a third of total earnings on an annual basis during the 1990s. The service sector now accounts for the second-highest percentage of total earnings in the economic study area (17 percent). This sector is followed by trade (11 percent) and transportation and utilities (10 percent). Industries reporting the greatest growth in earnings include manufacturing; finance, insurance, and real estate (F.I.R.E.); and services. But it should be noted that even though Figure 3-46 shows farm and agricultural services contributing the least amount of gross earnings from 1990 through 2000, studies indicate that agricultural production is an important contributor to the state's economy (Moline et al. 1991). For example, in a 2000 study, economists at the University of Wyoming compared

the income provided to county governments and public schools to the financial demands on community services from agricultural and residential developments. The study shows that on average in Wyoming, ranching activity generates nearly twice as much income for community services as it requires in expenditures on community services, whereas residential development generates about half as much income as it requires in expenditures (Taylor and Coupal 2000). These findings underscore the importance of agricultural production in terms of its contribution to local economies.

Another method of examining the importance of certain industries is to observe the trends in average earnings. Figure 3-47 shows the trends in average earnings for the study area for 1990–2000. Mining jobs remain the highest paying in the area, followed by transportation and manufacturing.

Industries showing the greatest percentage increase in earnings include manufacturing (37 percent), F.I.R.E. (31 percent), and services (18 percent). Although the government sector supports the greatest percentage of jobs and earnings in the study area, growth in real earnings for this sector has been relatively modest during the 1990s, increasing by 4 percent between 1990 and 2000.

Economic Base

An area's economic base comprises industries that are primarily responsible for bringing outside income into the local economy. These industries typically 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 traditionally has been tied to such factors as the natural resource base, cost factors (transportation and labor), and existing transportation infrastructure. However, technology has affected these location factors.

To assess the importance of major industries as a basic industry, location quotients were calculated for nine major industries, as listed in Table 3-17. A location quotient was calculated for both employment and income and compares each industry's share of total local employment or income to the industry's state or national share. This quotient yields a value generally between 0 and 2, where 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 3-17 shows that the four-county study area mirrors in many ways the state's economy as a whole. Industries that do show a stronger concentration in this area compared to the state's economy include manufacturing, transportation, utilities, and government. Two industries that are weak in this area compared with the state are mining and farm and agriculture services. When compared to the national economy, however, mining shows an extremely high concentration. This is also true for the government sector. Alternatively, manufacturing; F.I.R.E.; and services show weak concentrations compared with the national economy.

Table 3-17. Location Quotients for the RMPPA, 2000

Industry	Employment		Earnings	
	Location Quotient (Wyoming)	Location Quotient (U.S.)	Location Quotient (Wyoming)	Location Quotient (U.S.)
Farm and Ag Services	0.54	1.01	0.67	0.87
Mining	0.63	8.16	0.63	11.03
Construction	0.75	1.05	0.79	1.12
Manufacturing	1.04	0.40	1.42	0.48
Transportation and Utilities	1.05	1.17	1.12	1.42
Trade	0.94	0.97	0.90	0.77

Industry	Employment		Earnings	
	Location Quotient (Wyoming)	Location Quotient (U.S.)	Location Quotient (Wyoming)	Location Quotient (U.S.)
F.I.R.E.	0.96	0.88	0.96	0.51
Services	0.87	0.73	0.86	0.58
Government	1.28	1.92	1.38	2.08

Property Valuation and Taxation

Total property valuation for the four counties in the socioeconomic study area for 2001 is summarized in Table 3-18. This includes property assessed by the State of Wyoming as well as locally assessed property. The State of Wyoming assesses taxes on both mineral and nonmineral property. Nonmineral property assessed by the state includes airlines, utilities, pipelines and gas distribution systems, railroads, and telephone service (Wyoming Department of Revenue 2001). During fiscal year 2001, the valuation of property assessed by the state was \$1.66 billion for the socioeconomic study area.

Local government assesses four categories of property, including (1) agricultural land; (2) residential land, improvements, and personal property; (3) commercial land, improvements, and personal property; and (4) industrial property (Figure 3-48). During fiscal year 2001, the value of property assessed by local governments in the socioeconomic study area was almost \$947 million, as described in Table 3-18. The total value of assessed property in the four-county study area was \$2.6 billion in fiscal year 2001.

As illustrated in Figure 3-49, there has been dramatic growth in natural gas production in the socioeconomic study area. As a result, it continues to be a major source of tax revenue for local government entities. For example, Table 3-18 indicates that during fiscal year 2001 minerals accounted for nearly 55 percent of the total state and locally assessed property values in the study region. Moreover, the assessed value of minerals in Carbon and Sweetwater Counties represented nearly 77 percent and 70 percent, respectively, of the total state and locally assessed property values for these counties. But it should be noted that while Table 3-18 does indicate that the value of residential property is more than twice that of commercial or industrial property, it also illustrates that the value of residential property for the study area is only about 37 percent of the assessed value of mineral property. But regardless of the relative size of the assessed property valuations, if oil and gas development creates a degradation of the surrounding environment, residential property values are likely to suffer. But to quantify the change in residential property brought about by increased oil and gas activity is beyond the scope of this analysis.

Table 3-18. Assessed Property Values by County for 2001

County	Valuation of State-Assessed Property			Valuation of Locally Assessed Property					Total State- and Locally Assessed Property
	Non-Minerals	Minerals	Total State-Assessed Property	Agricultural Land	Residential Land, Improvements and Personal Property	Commercial Land, Improvements and Personal Property	Industrial Property	Total Locally Assessed Property	
Albany	\$23,792,281	\$3,324,167	\$27,116,448	\$5,636,217	\$107,891,145	\$34,425,664	\$6,475,411	\$154,428,437	\$181,544,885
Carbon	\$41,628,203	\$426,289,238	\$467,917,441	\$6,262,236	\$37,701,960	\$14,333,269	\$27,848,535	\$86,146,000	\$554,063,441
Laramie	\$44,719,001	\$17,992,517	\$62,711,518	\$9,790,261	\$265,897,775	\$98,510,417	\$28,210,102	\$402,408,555	\$465,120,073
Sweetwater	\$122,849,306	\$980,185,196	\$1,103,034,502	\$3,105,344	\$110,041,844	\$32,191,664	\$158,602,935	\$303,941,787	\$1,406,976,289
Total Study Area	\$232,988,791	\$1,427,791,118	\$1,660,779,909	\$24,794,058	\$521,532,724	\$179,461,014	\$221,136,983	\$946,924,779	\$2,607,704,688

Table 3-19 summarizes the assessed value of oil and gas production and property for fiscal year 2001 for each of the counties in the socioeconomic study area. For 2001, oil and gas production accounted for 75 percent of all mineral valuation in the socioeconomic study area as assessed by the state. For Carbon and Sweetwater Counties, oil and gas production accounted for 92 percent and 68 percent, respectively, of all assessed mineral production. Physical assets of the oil and gas industry (property) constituted an additional 2.7 percent of all property assessed by local governments. Of all property and production assessed by the state and local governments, oil and gas operations accounted for 42 percent of assessed value in the socioeconomic study area during fiscal year 2001.

Table 3-19. Assessed Value of Oil and Gas Production and Property in the RMPPA, FY2001

County	Oil and Gas Valuation—Production	Oil and Gas Valuation as Percentage of Total Mineral Valuation	Oil and Gas Extraction and Refining Property Valuation	Oil and Gas Property as a Percentage of Locally Assessed Property Valuation	Oil and Gas Valuation as a Percentage of Total State- and Local Assessed Property Valuation
Albany	\$1,866,033	56.14%	\$104,284	0.07%	1%
Carbon	\$393,684,237	92.35%	\$25,146,585	29.19%	76%
Laramie	\$10,676,916	59.34%	\$8,756,014	2.18%	4%
Sweetwater	\$670,371,775	68.39%	\$42,161,137	13.87%	51%
Total Study Area	\$1,076,598,961	75.40%	\$25,250,869	2.67%	42%

County Ad Valorem Taxes

Estimated ad valorem taxes from mineral production for each study county during calendar year 2001 are summarized in Table 3-20. These counties generated \$76 million in tax revenues from mineral production during 2001. Of this, \$67 million, or 88 percent, was derived from oil and gas production. Ad valorem taxes derived from mineral production accounted for 53 percent of total county tax levies in 2001.

Table 3-20. Estimated Mineral Ad Valorem Tax Revenues, FY2001

County	Natural Gas	Crude Oil	Coal	Trona	Granite Ballast	Sand and Gravel	Total	Property Tax Levy^a	Mineral Tax Levy as Percentage of County Tax Levy
Albany	\$0	\$117,446	\$0	\$0	\$0	\$5,094	\$122,541	\$12,481,661	1%
Carbon	\$22,455,265	\$1,927,568	\$2,001,986	\$0	\$0	\$17,404	\$26,402,224	\$34,927,573	76%
Laramie	\$21,974	\$710,730	\$0	\$0	\$438,322	\$58,908	\$1,229,933	\$34,322,378	4%
Sweetwater	\$35,541,587	\$6,989,927	\$6,544,036	\$13,083,494	\$0	\$28,479	\$62,187,523	\$89,145,656	70%
Total Study Area	\$58,018,826	\$9,745,670	\$8,546,023	\$13,083,494	\$438,322	\$109,886	\$89,942,220	\$170,877,268	53%

Table 3-21 provides an estimate of the ad valorem taxes assessed on physical property associated with oil, gas, and coal operations. During 2001, the four counties generated an estimated \$3.9 million in property taxes associated with oil, gas, and coal extraction assets.

Table 3-21. Estimated Ad Valorem Tax Revenues on Oil, Gas, and Coal Property, FY2001

County	Oil and Gas Property Assessment	Coal Property Assessment	Average Tax Levy	Total Estimated Ad Valorem—Property
Albany	\$104,284	\$0	62.94	\$6,564
Carbon	\$13,557,345	\$1,459,743	61.94	\$930,158
Laramie	\$813,889	\$0	68.63	\$55,857
Sweetwater	\$42,161,137	\$3,944,703	63.44	\$2,924,954
Total Study Area	\$56,636,655	\$5,404,446	124.88	\$3,917,534

Table 3-22 estimates the importance of oil and gas operations in terms of local government property tax revenues. The four counties in the socioeconomic study area generated \$71 million in tax revenues as a result of oil and gas operations. This accounted for 42 percent of property taxes generated in this area for 2001.

Table 3-22. Oil and Gas Tax Revenues as a Percentage of Total County Property Taxes, FY2001

County	Total Ad Valorem Tax Revenue—Oil and Gas	Property Tax Levy ^a	Oil and Gas Tax Revenue as a Percentage of County Tax Levy
Albany	\$124,010	\$12,481,661	1%
Carbon	\$25,222,507	\$34,927,573	72%
Laramie	\$788,556	\$34,322,378	2%
Sweetwater	\$45,206,413	\$89,145,656	51%
Total Study Area	\$71,341,486	\$170,877,268	42%

^a Wyoming Taxpayers Association, Wyoming Property Taxation, 2001.

State Mineral Severance Taxes

Local government entities as well as the state benefit from severance taxes collected on mineral production throughout the state. Table 3-18 shows that \$1.4 billion was assessed by the State of Wyoming for mineral production in the four-county socioeconomic study area during 2001. However, severance taxes collected on mineral production are distributed within the state according to a formula published in the state statutes (W.S. 39-14-801). These tax revenues are distributed to various sources, including the state general fund, state water development account, state highway fund, counties, cities, and towns. Therefore, the government entities in the socioeconomic study area will benefit from only a percentage of the severance taxes collected on production within the area. These entities, however, will also benefit from the severance taxes collected on mineral production in other parts of the state. Table 3-23

summarizes the total severance tax revenues that were distributed to the local government entities within the socioeconomic study area during fiscal year 2001.

Table 3-23. Total Severance Tax Distributions for Government Entities in the RMPPA, FY2001

Area	Severance Tax Distributions
Counties in Study Area	\$4,801,380
Total Severance Taxes Distributed to All Counties in Wyoming	\$13,843,706
Percentage Distributed to Study Area Counties	35%
Cities and Towns in Study Area	\$13,638,594
Total Severance Taxes Distributed to All Cities/Towns in Wyoming	\$35,370,306
Percentage Distributed to Study Area Cities/Towns	39%

Source: *Annual Report of the Treasurer of the State of Wyoming*, June 30, 2001.

Table 3-24 estimates the severance taxes generated from mineral production originating within the socioeconomic study area. The estimated severance taxes for each mineral type are based on production and assessed values and the effective tax rates, all of which were obtained from the Wyoming Department of Revenue, Mineral Tax Division. Natural gas production generated the most severance tax revenue in the socioeconomic study area, accounting for nearly 67 percent of all severance taxes generated, with the majority of production occurring in Carbon and Sweetwater Counties.

Table 3-24. Severance Taxes Generated in the Study Area by Product, FY2001

County	Natural Gas	Crude Oil	Stripper Oil	Coal—Surface	Coal—Underground	Granite Ballast	Trona	Sand and Gravel	Total	Percentage of Total Severance Taxes Generated in Each County
Albany	\$0	\$77,664	\$20,140	\$0	\$0	\$0	\$0	\$1,619	\$99,423	0.1%
Carbon	\$21,028,585	\$1,566,690	\$145,466	\$623,286	\$878,246	\$0	\$0	\$5,620	\$24,247,893	30.6%
Laramie	\$18,572	\$462,391	\$89,784	\$0	\$0	\$127,744	\$0	\$17,168	\$715,658	0.9%
Sweetwater	\$32,491,495	\$6,233,244	\$32,737	\$7,220,190	\$0	\$0	\$8,248,759	\$8,978	\$54,235,402	68.4%
Total Study Area	\$53,538,652	\$8,339,989	\$288,127	\$7,843,476	\$878,246	\$127,744	\$8,248,759	\$33,385	\$79,298,376	100.0%
Percentage of Severance Taxes Generated from Each Product	67.5%	10.5%	0.4%	9.9%	1.1%	0.2%	10.4%	0.04%	100.0%	0.0%

Federal Royalties

Mineral production occurring on federally owned public lands is also assessed a federal mineral royalty. Production of oil and gas and surface minable coal is assessed at 12.5 percent after allowable deductions. Coal mined by underground methods is assessed at 8 percent of value after allowable deductions. The Federal Government returns 50 percent of the total royalties collected to the state where the mineral production occurs. In Wyoming, distribution of the federal royalties is based on a formula promulgated by the Wyoming State Statutes (W.S. 9-4-601). The state allows a percentage of the federal royalties to be distributed to cities and towns for planning, construction, and maintenance of public facilities; capital construction funds; and transportation projects. Local school districts may also benefit from federal royalty payments through advanced entitlement grants for capital construction funds.

Total federal royalties distributed to local government agencies in the socioeconomic study area for the federal fiscal year 2001 amounted to \$6.04 million (Wyoming Department of Revenue 2001).

RMPPA Mineral Tax Revenues

Table 3-25 through Table 3-27 provide an estimate of the mineral tax revenues associated with oil and gas and common variety minerals production within the RMPPA for production year 2000. Actual production data were obtained from the Wyoming State Geologic Survey and were 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. Oil, gas, and coal production occurring within the RMPPA generated an estimated \$62 million in mineral tax revenues to the county, state, and federal governments (ad valorem, severance, and federal royalties) during fiscal year 2001.

**Table 3-25. Estimated Ad Valorem Tax on Production for the RMPPA
(Federal Lands)**

Product	Total Annual Production	Taxable Valuation Per Unit ^a	Assessed Valuation	Average Tax Levy ^b	Total Estimated Ad Valorem
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (4)/1000*(5)
Oil (BBLs)	1,557,123	\$24.47	\$38,102,800	58.849	\$2,242,312
Natural Gas (MCF)	81,540,962	\$2.60	\$212,006,501	58.849	\$12,476,371
Coal (Underground)	1,409,233	\$16.62	\$23,421,452	61.935	\$1,450,608
Coal (Surface)	705,958	\$3.91	\$2,760,296	61.935	\$170,959
Total			\$276,291,049		\$16,340,250

^a Source: Wyoming Department of Revenue Annual Report—Fiscal Year 2001, Cheyenne, Wyoming.

^b Source: Wyoming Taxpayers Association, "Wyoming Property Taxation 2001," Cheyenne, Wyoming.

**Table 3-26. Estimated Severance Tax on Production for the RMPPA
(Federal Lands)**

Product	Total Annual Production (BBLs/MCF)	Taxable Valuation Per Unit ^a	Assessed Valuation	Average Severance Tax Per Unit of Production ^a	Total Estimated Severance Tax
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (4)*(5)
Oil	1,557,123	\$24.47	\$38,102,800	0.060	\$2,286,168
Natural Gas	81,540,962	\$2.60	\$212,006,501	0.060	\$12,720,390
Coal (Underground)	1,409,233	\$16.62	\$23,421,452	0.070	\$1,639,502
Coal (Surface)	705,958	\$3.91	\$2,760,296	0.0375	\$103,511
Total			\$276,291,049		\$16,749,571

^a Source: Wyoming Department of Revenue Annual Report—Fiscal Year 2001, Cheyenne, Wyoming.

**Table 3-27. Estimated Federal Royalties on Production for the RMPPA
(Federal Lands)**

Product	Total Annual Production (BBLs/MCF)	Taxable Valuation Per Unit ^{a,b}	Assessed Valuation	Federal Royalty Rate	Total Estimated Federal Royalties
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (4)*(5)
Oil	1,557,123	\$22.92	\$35,689,259	0.125	\$4,461,157
Natural Gas	81,540,962	\$2.10	\$171,236,020	0.125	\$21,404,503
Coal (Underground)	1,409,233	\$16.62	\$23,421,452	0.125	\$2,927,682
Coal (Surface)	705,958	\$3.91	\$2,760,296	0.125	\$345,037
Total			\$233,107,027		\$29,138,379

^a Source: Wyoming Department of Revenue Annual Report—Fiscal Year 2001, Cheyenne, Wyoming.

^b The taxable valuation for oil and gas was decreased to account for allowable cost deductions taken by operators prior to paying federal royalties. Therefore, the taxable valuation per barrel of oil is 93.66% of total valuation and 80.95% of total value.

Other Tax Revenue Sources

Other tax revenue sources that may be affected by management actions associated with BLM-managed lands include lodging taxes (Table 3-28), sales and use taxes (Table 3-29), and gas taxes. Lodging taxes have ranged from \$0.93 million to \$1.2 million per year between 1999 and 2000 for the socioeconomic study area, whereas sales and use taxes generated between \$61 million and \$74 million during this time.

Table 3-28. Lodging Tax Distribution for the RMPPA

County	FY1999	FY2000	FY2001
Albany	\$176,937	\$278,992	\$296,795
Carbon	\$176,051	\$202,998	\$197,689
Laramie	\$333,245	\$379,875	\$408,164

County	FY1999	FY2000	FY2001
Sweetwater	\$247,099	\$270,368	\$307,111
Total	\$933,332	\$1,132,233	\$1,209,759

Source: Wyoming Department of Revenue Annual Report—FY 2001.

Table 3-29. Sales and Use Tax Distribution for the RMPPA

Jurisdiction	FY1999	FY2000	FY2001
Albany ^a	\$11,184,686	\$12,638,203	\$12,638,203
Carbon ^a	\$8,127,805	\$10,151,339	\$10,151,399
Laramie ^a	\$22,630,054	\$29,173,211	\$29,173,211
Sweetwater ^a	\$19,190,295	\$22,413,185	\$22,413,185
Total	\$61,132,840	\$74,375,938	\$74,375,998

Source: Wyoming Department of Revenue Annual Report—FY 2001.

^a Includes distribution to county and to cities and towns within each county.

Payment in Lieu of Taxes

Each county in the socioeconomic study area receives Payment in Lieu of Taxes (PILT) to compensate local governments for hardships caused by federal lands being exempt from local property taxes. PILT payments are allowed in addition to other revenue-sharing programs, such as federal mineral royalties and U.S. Forest reserve payments. The PILT payment 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. PILT payments received by the counties in the socioeconomic study area for the last 10 years are summarized in Figure 3-50.

Summary

Table 3-20 through Table 3-29 summarize the taxes in the study area and illustrate the various sources of tax revenues. While these tables provide a good summary of the magnitude, source, and distribution of taxes and royalties, a more detailed view of tax revenues by county can be found by visiting the State of Wyoming website: <http://eadv.state.wy.us/s&UTax/s&u.asp>.

3.12.4 Economic Activities Attributable to BLM Lands Within the RMPPA

Activities on BLM lands can provide important economic stimulus to local economies. For the RMPPA, activities such as oil, gas, and coal production; grazing; and recreation are important to the region. The following section discusses the link between activities on lands within the RMPPA and the local economy.

Oil and Gas Operations

Historical data for oil and gas production between 1974 and 2000 were used to estimate annual production for the RMPPA, summarized in Figures 3-51 and 3-52. As shown in the figures, the RMPPA continues to be a very important area in terms of oil and gas production. For instance, Sweetwater County had the third-highest taxable valuation of crude oil and natural gas of all counties throughout Wyoming during 2001. A significant percentage of this production occurred on BLM-controlled acreage.

Although the region's mining employment and income have declined recently, mining remains a strong industry within the study area, especially for its western portions, which depend more on mining than the eastern counties.

Livestock Grazing

Grazing is another important use of BLM-managed lands within the RMPPA. An estimate of the importance of this use in the four-county study area is summarized in Table 3-30 and Table 3-31. The value of grazing on BLM-managed public lands was calculated as shown in Table 3-30. Total annual AUMs were obtained from BLM for the period from 1990 to 2000. Using data for the number of AUMs used in 1997 and for the value of cattle and sheep sales from the Wyoming Statistical Service, the value of grazing on BLM-managed public lands for the RMPPA was estimated at about \$11.6 million. The value of grazing associated with the RMPPA was then compared with livestock sales during 1997 for the four-county socioeconomic study area. The most recent data on sales were obtained from the 1997 Census of Agriculture published by the National Agricultural Statistical Service. According to Table 3-31, total agricultural sales in the four-county area exceeded \$153 million, of which nearly 50 percent was associated with livestock sales. Comparing livestock sales throughout the study area with the value of grazing on BLM-managed lands within the RMPPA indicates that grazing activities accounted for slightly over 15 percent of all livestock sales and almost 8 percent of all agricultural sales for this area.

Table 3-30. Estimated Value of Grazing Activities on BLM Lands Within the RMPPA for 1997

Total Cattle AUMs Attributable to Grazing Within RMPPA—1997	Total Sheep AUMs Attributable to Grazing Within RMPPA—1997	Value of Cattle Grazing (\$1,000) ^a	Value of Sheep Grazing (\$1,000) ^b	Total Value of Grazing on BLM Lands (\$1,000)
309,725	30,977	\$10,930	\$670	\$11,600

^a Cattle Grazing was valued per AUM at \$35.29/AUM (real 2001\$) based on data from the Wyoming Agriculture Statistical Service (Appendix 35, Table A35-3).

^b Sheep Grazing was valued per AUM at \$21.63/AUM (real 2001\$) based on data from the Wyoming Agriculture Statistical Service (Appendix 35, Table A35-4).

Table 3-31. Percentage of Agricultural Sales in the Study Area Attributed to Grazing on BLM Lands in the RMPPA

Total Agricultural Sales—Study Area (\$1,000)	Total Cattle and Calf Sales—Study Area (\$1,000)	Estimated Value of Grazing on BLM Lands—RMPPA (\$1,000)	BLM Grazing Percentage Based on Estimated Total Value of Grazing on BLM Lands	Grazing Percentage of Total Agricultural Sales
\$153,329	\$76,353	\$11,600	15.19%	7.57%

Source: U.S. Department of Agriculture, National Agriculture Statistical Service, Census of Agriculture, 1997.

Recreation

Recreational activity has important economic value in terms both of satisfaction provided to local residents and economic activity generated for the regional economy. In terms of economic activity, recreation generates additional spending in the local economy that supports jobs and income. Estimates of recreational use within the RMPPA indicate that over several hundred thousand recreational visitors days

are spent in this area. As visitors come to this area to recreate, they spend money on goods and services to support their activities, including lodging, meals and groceries, gasoline, and other items. These expenditures can be an important economic stimulus to the local area.

3.12.5 Environmental Justice

Executive Order 12898, Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations, requires the identification and addressing of disproportionately high and adverse human health and environmental impacts of federal programs, policies, and activities on minority and low-income populations.

Relevant census data were used to determine whether the populations residing in the four-county study area constitute an “environmental justice population” through meeting either of the following criteria:

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

Population by Race

Table 3-32 summarizes population distribution by race for all counties in the study area. In addition, Map 3-8 shows the minority population for each county in Wyoming, where minority population is calculated as total population less non-Hispanic white alone. All four counties show minority populations greater than the state average. This is mainly attributable to the larger Hispanic population in the four counties compared with the rest of the state. Laramie County also has a slightly higher African-American population than the rest of the state, probably because of the racial diversity of personnel associated with F. E. Warren Air Force Base in Cheyenne.

Table 3-32. 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)
Albany	91.3	1.1	1.0	1.7	0.1	2.6	2.2	7.5
Carbon	90.1	0.7	1.3	0.7	0.1	5.2	2.1	13.8
Laramie	88.9	2.6	0.8	1.0	0.1	4.0	2.6	10.9
Sweetwater	91.6	0.7	1	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

Source: U.S. Bureau of Census.

Percentages may not add to 100 because individuals may report ethnicity under more than one category.

However, the greater percentage of minority populations living in the four-county study area is not sufficient to constitute an “environmental justice population” because it does not meet either of the criteria above.

Population in Poverty

Poverty level is often used as a determinant 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, then the family and all individuals of that household are considered to be in poverty. Using this criterion, the Census Bureau provides estimates of the percentage of individuals who fall below the poverty level for each county in the United States. Poverty estimates are also provided for different regions of the United States and for the nation as a whole.

Table 3-15 summarizes the estimated poverty rates for the four counties in the socioeconomic study area, for Wyoming, for the West, and for the United States. Carbon, Laramie, and Sweetwater Counties have estimated poverty rates over the past decade that are below the state, regional, and national averages. The exception is Albany County, whose estimated poverty rates are higher than all other areas summarized. (Carbon County showed a slightly higher poverty rate than the State of Wyoming for 1998.)

Map 3-9 summarizes the median household income and poverty rates for each county in Wyoming for 2000. The map shows that the median household income in Laramie and Sweetwater Counties is above the state average, and poverty levels (Table 3-15) are lower than poverty levels throughout the state. This indicates the absence within these two counties of low-income populations that could be affected by BLM actions. This is not the case in Carbon and Albany Counties, however: these counties reported a lower median household income and higher poverty rates than found throughout Wyoming. For Albany County, the poverty rate is 10 percentage points above the state average, indicating the potential for a low-income "environmental justice population." This issue will require further analysis to determine whether low-income populations may be affected by BLM management actions.

3.12.6 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. The Rawlins RMPPA historically was developed with sparse populations, rural characteristics, and natural resource-based economies. Although no two communities within the RMPPA are alike, many do 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 Rawlins RMPPA.

Carbon County Communities

Baggs

Located 76 miles from Rawlins and 41 miles from Craig, Colorado, Baggs was named after ranchers George and Maggie Baggs. Initially established mostly as a ranching community, the area continued to develop as settlers came to the area in search of gold and silver. The community of Baggs is also reputed to be the former home of one of the most notorious outlaw bands of the Old West, which included Butch Cassidy, the Sundance Kid, and their "Wild Bunch." Today the small community of Baggs consists of a little over 350 residents, who benefit from the oil and gas activity of the area as well as ranching, seasonal recreation, tourists services, and access routes to the national forest that surrounds the community.

Elk Mountain

The rural community of Elk Mountain grew around the Elk Mountain Stage Station along the Overland Trail. In 1877, a post office was established to service the town and ranches that were being settled in the region. With the growth of the railroad and availability of rangeland for raising stock, the area saw economic growth. Gold was discovered in Douglas Creek, which drew a large number of miners to the Medicine Bow Range. In 1897, copper was found on the west side of Elk Mountain. After the establishment of the Union Pacific Railroad 15 miles to the northeast, ranchers began using the rich rangelands for cattle grazing. Elk Mountain's first mercantile store was constructed in 1902 using lumber from the timber company. In 1915, the Carbon Timber Company sold its assets to the Hanna-based Wyoming Timber Company, which dominated the local logging scene for the next 4 decades. Mineral

explorations in the second half of the 19th century revealed deposits of gold and copper in the region. The boom lasted for only a decade but played an important role in the economic development of Elk Mountain. The energy boom of the 1970s caused an influx of miners and their families to the area. Communities grew and allowed improvements to the lifestyle of their residents. A constant of the area has always been the ranching industry: the raising of quality animals and hay crops has made this a place of agricultural importance.

Encampment and Riverside

Originally known as “Grand Encampment” (a name subsequently changed in accordance with a U.S. Postal Service request for a shorter name), Encampment was incorporated in January 1898. Situated between two noncontiguous sections of the Medicine Bow and Routt National Forests in south-central Wyoming, the area was originally settled as a ranching and sheep herding area. In 1897, Ed Haggarty, a sheep rancher and prospector, discovered a prolific copper source in the Sierra Madre Mountains, subsequently starting a copper boom. That same year a prospector from Whitehaven, England, discovered a rich copper prospect that he named the “Rudefeha.” The property and mine, which soon came to be named the “Ferris-Haggarty property,” produced much of the more than \$2 million of copper from this area of Wyoming.

Seeking capital and development of the region was the foremost advocate or promoter of the Grand Encampment Mining Region, Willis George Emerson. Upon obtaining an interest in the Ferris-Haggarty property and establishing a plethora of companies, promoter Emerson attracted dollars toward the construction of such entities as a 4-mile wood and iron pipeline designed to supply power to the smelter and an aerial tramway. The tramway extended for 16 miles from the Ferris-Haggarty Mine, over the Continental Divide at an elevation of 10,700 feet above sea level, down through the mountains and across the valley floor to the smelter at Encampment. By 1904, the mining operations were at their apex, employing 200 men and producing over \$1.4 million of copper. Foreclosure proceedings began in 1913, and salvage operations followed shortly thereafter.

Although through the first decade of the 1900s Encampment was considered one of the most prosperous towns of the West as a result of the discovery of gold near the Encampment River, the Grand Encampment copper region epitomizes the boom and bust syndrome of many western mining areas.

The town of Riverside, previously known as Dogget, came about as a means of getting to the town of Encampment. Located between Saratoga and Encampment, Riverside’s fortunes were directly tied to the copper industry of Encampment. Although Riverside was never a major mining town, smelter workers stayed at the local Riverside hotel and frequented the saloons, giving Riverside the appearance of a promising mining community. Once the mining and smelter companies of Encampment started to decline, so, too, did Riverside. Today, Riverside’s population is approximately 85. The town is considered primarily an agricultural and ranching community, with some timber mill activity and recreational services associated with the national forest.

Today, the small towns of Riverside and Encampment contain a number of second homes and retirement homes situated near a wealth of recreational opportunities.

Hanna

The founding of Hanna was due primarily to its association with the Union Pacific Railroad route and the discovery of coal. The town was formed in 1886 by Mark A. Hanna, a financier and politician who was on the board of directors of the Union Pacific Railroad. Despite Hanna’s grand visions and the potential for coal in Hanna, the town began as a small tent town.

As the coal industry grew, so did the town of Hanna. Most of the town’s residents were mine workers who emigrated from Finland, England, Sweden, Japan, and Italy. To accommodate the growing population, Union Pacific began building up much of the town, which soon became characterized by

orderly streets and alleys concentrated between the town's two mines. In 1903, a mine explosion killed 169 men in the worst mine disaster in Wyoming's history, and in 1908 another explosion killed 59. The mine was subsequently closed, and a memorial, which still stands today, was erected just above the mine.

Hanna continued to grow as additional mines were opened. In 1954, when the Union Pacific Railroad began using the diesel locomotive in place of the coal-fueled locomotive, Hanna became a ghost town. However, in 1965, Union Pacific gave Hanna water rights and land, and the town began to survive on its own. Ranching and other occupations aided in the town's survival, as did some renewed interest in coal during the energy boom of 1970. Between 1970 and 1990, Hanna was revived with renewal of the coal industry. (Through its coal, the town was referred to as having "black blood running through its veins.")

During its booming coal days, Hanna's population reached about 1,500. More recently, the population has been estimated to be fewer than 900 inhabitants. The most probable reason for the town's population decrease is the closing of its mines. Although the Shoshone underground mine was able to remain competitive longer than most because it used longwall mining techniques (which efficiently cut away coal by running back and forth along the coal seam), it, too, has closed.

Outside of the mining industry, Hanna virtually has no other major (or even medium-sized) employer. Although there are plans for a new mine southeast of town, lagging coal prices have forced delays. However, there is a newly developed wind energy business nearby, and other economic opportunities exist from Hanna's proximity to Seminoe State Park and Reservoir and Medicine Bow National Forest.

Rawlins and Sinclair

During the spring of 1868, members of the grading crew of the Great Iron Horse Railroad established a camp at Rawlins Spring. The camp was named after General John A. Rawlins, Chief of Staff of the U.S. Army, who, after taking a drink from the spring, stated that if ever something were named for him, he hoped it would be a spring of water. From this camp a tiny town began to grow. A Post Office was established, work on the Union Pacific depot was begun when the tracks finally reached Rawlins, and the town was made a central hub of the railroad.

Rawlins is significant as the original commercial heart of the county seat of Carbon County. From its humble origins as one of hundreds of railroad towns along the Union Pacific mainline, Rawlins grew into a modern city with a diversified economy that today serves a regional ranching, oil and gas, and industrial community. Because of its location on the first transcontinental railroad and its status as a permanent water source in an otherwise semi-arid region, Rawlins became a major division point for the Union Pacific Railroad. In the 20th century, the city was located on the first transcontinental auto highway, the Lincoln Highway. As such, it has played a key role in state, regional, and national transportation. Today, the main industry in Rawlins is the oil business. There are several pipelines in the Rawlins area.

Rawlins is also the home of the Wyoming State Penitentiary, a major employer of the area located just a few miles south of town.

Located just 6 miles to the east is the small Wyoming community of Sinclair, home of the Sinclair Refinery, which boasts of itself as "The West's Most Modern Refinery." First known as Parco, Sinclair was described by the *Rocky Mountain News* in August 1925 as "truly an oasis in an otherwise drab desert territory."

Sinclair was financed by oil magnate Frank Kistler to house workers for a large Producers and Refiners Oil Company refinery built in 1922–1923 at the location. Designed by the Denver-based architectural firm of Fisher and Fisher and constructed in 1924–1925, the company-built town of Sinclair consists of numerous public buildings set around three sides of a central east-west plaza, fountain, and park. Residences are located along streets and blocks in a grid pattern running north, west, and east from the plaza area. To foster the community spirit that is commonly absent in company towns as well as to maintain architectural cohesiveness, Sinclair's architects designed both residential and public buildings

with Spanish Colonial motifs of unpainted stucco, polychrome clay tile roofs, and dominant masonry construction to accurately simulate the appearance and form of many southwestern adobe missions.

Although Kistler's firm was forced to sell the Parco holdings in 1934 when crude oil reached an all-time low price of 10 cents a barrel, the oil market improved as a result of increased demand during World War II. The refinery and town, renamed Sinclair in 1942, prospered under the management of the Sinclair Refining Company. From its inception, Sinclair has been one of the most important refineries in the State of Wyoming.

Saratoga

For more than 95 years, people have been drawn to Saratoga and the Platte Valley by the spectacular mountain scenery, superior trout fishing, trophy-class hunting, and abundant wildlife. Long considered the crossroads, as well as a destination, for American Indians and European-American settlers, Saratoga today is a town of approximately 2,000 residents situated on the banks of the North Platte River. Like that of many Wyoming communities, the early history of Saratoga is rooted in the mining, timber, and livestock industries and in the railroad. Many prominent cattle ranches are strung along the valley. A significant part of Saratoga's history also revolves around its world famous mineral hot springs and thermal waters, which were initially used by Native Americans who believed that the springs were medicinal. Today, the State of Wyoming manages the springs and has made modern upgrades to give the springs a spa-like atmosphere. Also contributing to Saratoga's development was the presence of the timber industry, which included a sawmill operation that lasted for many years.

During the 1940s, a Civilian Conservation Corps camp was established in Saratoga. One of the group's primary tasks was to construct the Barrett Ridge winter recreation area. Today, recreation and the hot springs continue to be the primary attractions of Saratoga. The destination is also home to one of the national fish hatcheries operated by the U.S. Fish and Wildlife Service (USFWS). Dating back to 1915, the hatchery raises a variety of trout species. Eggs from the fish are shipped to federal and state hatcheries nationwide, where they are raised for stocking.

Carbon

The town of Carbon was founded by the Union Pacific Railroad and was the first mining community on the main Union Pacific line. The first miners to Carbon dug caves into the sides of a nearby ravine and covered the fronts with boards and earth. Later the dwellings were made of sandstone. Flat rocks were piled on top of each other; chinking was of rock, sticks, or wood; and the inch-thick interior walls were of plaster made from sandstone. At its peak, Carbon had seven coal mines worked by "Lankies" (because several miners came from Lancashire, England). Three thousand residents lived in Carbon, and there was a general store, Scranton House, two or three saloons, Carbon State Bank, the *Slack Diamond* newspaper, a school, Miners Hall, two churches, and the large Finn Hall.

However, the town of Carbon was doomed by Simpson Hill, a steep grade west of town that required helper engines for about 6 miles to the top of the hill. In 1899, railroad surveyors found an easier grade through present-day Hanna, which happened at about the same time the Carbon mines were playing out. By 1902, the town of Carbon was abandoned because of these economic losses. Today, all that is left of Carbon is the Carbon Cemetery north of the town site, along with a few partial foundations and sandstone walls. The first grave in Carbon was that of the stable boss who fell victim to a flock of Indian arrows shortly after the camp started to take shape. The local outlaws "Dutch Charlie," who was hanged in Carbon, and "Big Nose-George," who was hanged in Rawlins, are also buried in the Carbon Cemetery.

Medicine Bow

The name "Medicine Bow" is legendary and derives its origin from the Indian tribes that frequented the area, mainly the Arapaho and Cheyenne. Along the banks of the river, Native Americans found excellent

material for making their bows. Anything that was found good for a purpose was called “good medicine.” Thus, these Native Americans named the river flowing through the area “the Medicine Bow River.” Because the headwaters of the river originated in the mountains to the south, these mountains were called “the Medicine Bow Mountains.”

Trappers and mountain men and women first used the Medicine Bow area during the 1830s. In 1868, the Union Pacific Railroad was built through the area, and a pumping station was established on the river. A store and saloon marked the beginnings of the small village, which naturally was given the name “Medicine Bow.” By the following year, Medicine Bow had become a major supply point, and in the 1870s, the Federal Government operated a military post in Medicine Bow to protect the railroad and freight wagons from Indian attack. A Post Office was built, and, in 1876, the first elementary school was established.

By the late 1870s and early 1880s, Medicine Bow had become the largest shipping point for range livestock on the Union Pacific line. Cattle were brought in for shipping from as far away as Idaho and Montana, and an average of 2,000 head a day were shipped. By the turn of the century, Medicine Bow was also a major shipping point for wool, averaging 1,000 tons a year.

In 1901, the Union Pacific Railroad was relocated from the Rock Creek route to its present location, and a depot was built in Medicine Bow. The original depot burned down July 24, 1913, and the present depot was erected in November 1913. In late 1913, the transcontinental Lincoln Highway passed directly through Medicine Bow. In the 1930s, the highway was paved, bringing tourism to the area. In later years, lumber, uranium, coal, oil, and natural gas were found in the Medicine Bow area, adding to the prosperity of the region.

Arlington

In the 1860s, the Rock Creek Crossing and Stage Station was one of many stopping points, or waystations, along the Overland Trail, a central trail among many western transcontinental transportation routes. As a stage station (known as a “home station”), Rock Creek (now known as “Arlington”) became a commercial and entertainment center for immigrants. Joe Bush, owner of the stage station, constructed a bridge at the crossing and lived in a log cabin at the site. To serve the many needs of travelers, Bush operated a dancehall-saloon, general store, and blacksmith shop from one building. Although travel along the Overland Trail declined after the transcontinental railroad was completed, Rock Creek continued to thrive as a supply and social center for growing agricultural and timber interests in the surrounding area. In 1882, a Post Office known as “Rock Dale” was constructed at the site. The Post Office was used as a bunkhouse in later years. In the 1890s, the dancehall-store-blacksmith shop also served as a school.

Although Rock Creek still served as a commercial and social center during the latter part of the 19th century, the economic base of the small settlement began to change. For economic purposes, the owners of Rock Creek station turned to stock raising during this period. Corrals, a barn, a milkhouse, and an icehouse were built during the 1880s and 1890s. During the early 20th century, Rock Creek was renamed “Arlington” and continued in its dual commercial-agricultural role.

The original Wyoming Wind Project, located on Foote Creek Rim above Arlington, had an initial output of more than 85 megawatts of electricity, enough for about 27,000 average homes. Electronic control systems point each turbine into the wind and adjust the pitch of the blades to make the best use of wind at any speed. The turbines can generate power at wind speeds of 8–65 miles per hour. At higher speeds, the turbines automatically shut down—a feature that allows them to withstand Wyoming’s 125-mile-per-hour gusts. The turbines are also adapted to operate reliably in extremely cold conditions.

Since development of the original 69-turbine project, several subsequent phases have been constructed, and the project now totals 183 turbines, with a generating capacity of 134.7 megawatts.

Rock Creek's historical significance relates to its evolution from a home station along the Overland Trail into a permanent ranching community. As one of the earliest settlements in Carbon County, Rock Creek contributed in the commercial and social senses to the development of south-central Wyoming.

The Stone Wall Ranch was the first permanent ranch homestead within the Little Snake River Valley. Founded in 1871 by one of the valley's first permanent cattle-raising residents, Noah Reader, the ranch retains material cultural elements that embody the relationship between stockmen and the local environment, elements that express an articulation between a mode of livelihood and local environmental constraints. The ranch's name derived from the natural sandstone escarpment that still forms the back (north) wall of the ranch's main corral. The Stone Wall Ranch is significant as the first permanent settlement in the Little Snake River Valley and because of its unique environmental setting. Cultural elements of the property are integrated with the environmental features, eliciting a feeling of confinement rather than of the open spaciousness so common among Wyoming ranches.

Albany County Communities

Albany

With the construction of the Laramie, Hahn's Peak and Pacific Railways (LHP&P), the railhead location in Albany provided a convenient central location where local miners and logging companies could take advantage of the more efficient transportation system to get their products to markets in Laramie and beyond. The LHP&P also provided a faster and less expensive means of transporting mineral ores and wood products than local wagon freighters offered. During the 1920s and 1930s, summer-home tracts were established outside of Albany on USFS-administered land, and soon the community of Albany witnessed an influx of eastern visitors taking advantage of the area's recreational opportunities.

Centennial

The Centennial Valley received its first major influx of people as a result of two pivotal government acts: the Homestead Act of 1862 and, more directly, the Pacific Railway Act that supported the construction of the transcontinental railroad in 1868. The first settlement of Centennial was actually located 1 mile southwest of the present town. The area around Centennial has always been used for its extensive grazing lands, and there is also ore and timber. Although Centennial largely can be characterized by its long history of logging, mining, and grazing ventures, tourism and recreation have contributed to the growth of the area both historically and today. The wild lands, undeveloped forest, and surrounding rangelands of Centennial have been enjoyed recreationally since as early as 1914. Considered the gateway to the Snowy Range ski area, Centennial is a year-round destination for a variety of recreational opportunities due to its proximity to the Medicine Bow Mountains.

Laramie

The county seat of Albany County, Laramie is located in southeastern Wyoming along I-80, on the banks of the Laramie River near Ames Monument. Various adventurers—including French trapper Jacques La Ramie, after whom the city is named—traversed the area around Laramie. Spurred by the railroad's arrival in 1868, the town of Laramie was incorporated in 1874. Laramie is home to the historic Territorial Prison. The 42-cell prison opened in 1872 and housed more than 1,000 men and 12 women prisoners, including Butch Cassidy, who was imprisoned there for stealing horses in 1894. Today the prison includes state-of-the-art displays and interactive exhibits on frontier law and justice as well as other facets of western history. Laramie is home to the University of Wyoming, which was established in 1886 and is today one of the major employers in the town. To meet the needs of a student population of roughly 10,000 (in comparison with a total city population of a little over 27,000), there exist a number of service industry opportunities in and around the University of Wyoming.

Laramie has become a transportation and commercial hub for timber-producing and ranching interests. Tourism and recreation also contribute significantly to the economy.

Rock River

Rock River came into existence as a result of the rerouting of the Union Pacific Railroad in 1898. With this change, the neighboring cow town of Rock Creek was abandoned when a railroad stop was established in Rock River. Along with the residents, many of the businesses of Rock Creek moved to Rock River. Rock River was established in 1910. In 1919, oil was discovered 14 miles west of town, in what is now called “McFadden.” The economy flourished, and hopes ran high that a refinery would be established, but the oil was instead piped to a refinery in Laramie.

Today, the population of Rock River is approximately 235, with the majority of those persons involved in agriculture and grazing.

Jelm

Three-and-a-half miles south of Woods Landing, in the bottomland of the Big Laramie River, is the site of Cummins City, later named “Jelm.” Placer gold is reported to have been discovered in the Medicine Bow Range as early as 1858, and Cummins City developed as a mining camp. In 1879, new prospects were discovered in gold-bearing quartz along the Upper Big Laramie River at Jelm Mountain. John Cummins promoted his mining interests in the region, and by 1880 a plot for the new town, called “Cummins City,” was drawn up. Numerous buildings were erected, including cabins, a boarding house, a meat and vegetable market, a paint store, restaurants, blacksmith shops, a livery stable, and at least one bar. However, by the end of 1881, Cummins City began to decline, and by 1886 it was reported that, with two exceptions (at a copper mine and a bismuth mine), no mining had been done in the Cummins City district.

Later, near the turn of the century, interest in the mining district was revived by the discovery of copper in the Medicine Bow and Sierra Madre ranges. In 1898, the Jelm Mining District was created. A new town plan was drawn up, and in 1900 Cummins City was resurrected as Jelm.

Mining carried on intermittently at Jelm, although it was not a large or permanent settlement.

Laramie County Communities

Cheyenne

The City of Cheyenne began in 1867, when the Union Pacific Railroad came through on its way to the west coast. The town site was first surveyed by General Grenville Dodge and was named for an Indian tribe that roamed the area. Settlement came so fast to the area that the nickname “Magic City of the Plains” was adopted for Cheyenne. On August 8, 1867, the first charter for the government of the City of Cheyenne was established, and H. M. Cook was elected the city’s first mayor. At that time, Cheyenne was situated in the Dakota Territory and had a population of approximately 600 people. The following December, a permanent city charter was granted by the Dakota Territory legislature. On January 5, 1914, the commissioner form of government was formally adopted by the City of Cheyenne.

With a recent population of over 53,000, Cheyenne is strategically situated at a major transportation hub (the intersection of Interstates 25 and 80 and two major railroads), and is a developing center of commerce. Only 90 minutes north of Denver, Colorado, Cheyenne sits as the northern anchor city of the Front Range of the Rocky Mountains. Cheyenne is the capital of Wyoming, the seat of Laramie County, and the site of F.E. Warren Air Force Base. Its economic base is extremely diverse, ranging from state and national government to the high-technology of satellite communications.

Sweetwater County Communities

Bairoil

The town of Bairoil is located about 40 miles north of Rawlins and 90 miles south of Casper. Bairoil acquired its name from Charles Bair, who was involved in drilling the first well there in 1916. The town began as the Bair Camp, built by the Bair Oil Company in the midst of the oil wells. In 1924, the name “Bairoil” became official when residents requested that a Post Office be established and that it be called “Bair Oil.” Over the years, the name evolved into its present spelling.

Rock Springs

Rock Springs is in southwestern Wyoming on Bitter Creek, 12 miles east of Green River. Named from a nearby saline spring, Rock Springs has been home to as many as 57 different nationalities in its long history and is a “melting pot” of cultural diversity. The first occupants were Paleoindian hunters and gatherers who arrived from Siberia through Alaska more than 20,000 years ago. The Shoshone were the largest tribal group, at around 1,800 in number, but there were also smaller numbers of Arapaho, Crow, Cheyenne, and Oglala and Brulé Dakota (Sioux). Rock Springs began as a stage stop in 1862 and developed as a coal-mining and ranching center after the arrival of the Union Pacific Railroad in 1868. The region around Rock Springs has rich underground stores of coal, oil, natural gas, trona, and phosphates. The railroad had been given the rights to the coal along its route, and it immediately opened coal mines near Evanston and Rock Springs, bringing in Chinese miners for less expensive labor and to aid in mining strikes. Racial tensions ensued, and on September 2, 1885, rioting led to the deaths of 29 Chinese workers. During the boom years of the 1980s, Rock Springs was the richest city in the nation on a per capita basis, yet its crime rate was also one of the highest in the nation. Then came the bust, with jobs disappearing as the town’s underground coal mines began subsiding.

Today, Rock Springs is slowly stabilizing in both its economy and its appearance. Its main economic contributors continue to be mining and coal-supporting companies, such as the Trona mining and processing company, Bridger power plant and coal company, and PacifiCorp, as well as Union Pacific Railroad, services for I-80, and other services including schools and hospitals.

Wamsutter

Wamsutter is located in Sweetwater County in southwestern Wyoming, 65 miles east of Rock Springs. With a population of 261 as of 2002, this small town is referred to as “the Gateway to the Red Desert.” The Wamsutter train station was created when the Union Pacific Railroad built its tracks through the area in 1868. The name of the town was originally “Washakie,” after the great Shoshone Chief. Because freight intended for Fort Washakie was mistakenly sent to the town of Washakie, the Federal Postal Service requested a name change in 1884 or 1885. Wamsutter was named either after a German bridge builder on the Union Pacific Railroad or after the Wamsutta Woolen Mills of Massachusetts. At one time, Wamsutter was considered the second-largest wool shipping point in the United States, and Wamsutta Mills was the largest buyer. (“Wamsutta” is a name applied to the cotton cloth manufactured at Wamsutta Mills in New Bedford, MA. The name is after a Massachusetts sachem, or chief, who was the eldest son of Massasoit, a Wampanoag. “Wamsutter” is apparently a contraction of “Womosutta,” meaning “Loving Heart.”)

The transportation facilities offered by the Union Pacific Railroad and the fine grazing land of the Red Desert, where half-a-million sheep winter annually, are the main factors in the growth and development of this small town. Wamsutter was incorporated on April 21, 1914. The area around the town is rich in underground stores of coal, oil, and gas. The main contributor to Wamsutter’s economy continues to be mining, supplemented by sheep and cattle farming.

3.13 SPECIAL DESIGNATIONS AND MANAGEMENT AREAS

Special designations and management areas (SD/MA) are designated to protect or preserve certain qualities or uses in areas that best provide them. The environment in these areas is unique in some respects, and it is therefore desirable to apply different management prescriptions to these areas than to areas of the surrounding public lands.

This section identifies the various SD/MAs within the RMPPA and addresses the qualities or uses that have resulted in their designation. The types of special management designation addressed in this section are WSAs, Areas of Critical Environmental Concern (ACEC), NNLs, and WSRs.

3.13.1 Wilderness Study Areas

There are no designated wilderness areas in the RMPPA, but there are five WSAs located within the RMPPA (Map 2-6). These are as follows:

- Adobe Town WSA
- Ferris Mountains WSA
- Encampment River Canyon WSA
- Prospect Mountain WSA
- Bennett Mountains WSA.

WSAs are managed according to the non-impairment standard. Under this standard, these lands are managed in a manner so as not to impair the suitability of such areas for preservation as wilderness. Unless otherwise noted, all information in this section was obtained from the Wyoming Statewide Wilderness Study Report (USDI, BLM 1991).

Adobe Town WSA

The Adobe Town WSA consists of a single study area within the Rawlins and Rock Springs Field Office administrative boundaries. This WSA includes 32,650 acres of BLM-managed lands within the RMPPA. The WSA is located in southeastern Sweetwater County, 25 miles south of Wamsutter. It is bounded on the north by the checkerboard land pattern and the Manual Gap Road, on the west by the Adobe Town Rim Road, on the south by a fading two-track, and on the east by the Willow Creek Road.

Adobe Town WSA was studied under Section 603 of FLPMA and was included in the Final Adobe Town-Ferris Mountains Wilderness EIS filed in January 1988. Based on information from that document, the BLM Wyoming State Office recommended that 10,920 acres of the original 82,350 be recommended for wilderness designation. The recommended portions include most of the heart of the Washakie Basin, an ancient inland sea. This portion of the WSA is a very colorful and rugged desert badland area, virtually untouched by human activity. Skull Creek Rim, in the heart of the area recommended for wilderness designation, contains some of the most unique and extensive badlands formations in Wyoming.

Ferris Mountains WSA

The Ferris Mountains WSA includes 21,880 acres of BLM-managed public lands and one privately owned inholding of 160 acres. The WSA is located in northwestern Carbon County, about 40 miles north of Rawlins. The Ferris Mountains are a small mountain range, rising abruptly from the gently rolling plains that surround the WSA. The WSA is bounded on the north by the rolling plains of the Sweetwater Valley, on the south by the level expanses of Separation Flat, on the west by Muddy Gap, and on the east by Miners Canyon.

The Ferris Mountains WSA is extremely steep and rugged, providing unusual and spectacular scenery. Along the southern flank, a formation of limestone outcrops forms a prominent white band 12 miles long, which is visible for up to 50 miles under proper lighting conditions. At 10,037 feet, Ferris Peak is the highest point in the Great Divide Basin, rising nearly 3,500 feet from the valley floor. Vegetation consists of coniferous trees, aspen, shrubby plants, grasses, and forbs. The WSA also contains grassy meadows and riparian areas.

Ferris Mountains WSA was studied under Section 603 of FLPMA and was included in the Adobe Town-Ferris Mountains Wilderness EIS filed in January 1988. The BLM Wyoming State Office recommended that all 21,880 acres be designated as wilderness.

Encampment River Canyon WSA

The Encampment River Canyon WSA includes 4,500 acres of BLM-managed lands, with no inholdings or split-estate lands. The WSA is located in southern Carbon County, approximately 2 miles south of Encampment and 1 mile north of the USFS Encampment River Wilderness. It lies in the foothills of the Sierra Madre. The Encampment River bisects the WSA.

The topography of the entire unit is mountainous. Steep canyons and rocky slopes dominate the vistas. The Encampment River and a major tributary, Miner Creek, add scenic features to the WSA. Elevations range from 7,260 feet along the Encampment River to 8,545 feet on the high ridges.

Approximately 10 percent of the Encampment River Canyon WSA is forested. Tree species include limber pine, lodgepole pine, Douglas fir, subalpine fir, cottonwood, and aspen. These species occur in pure and mixed stands scattered throughout the WSA. Narrow belts of deciduous trees, coniferous trees, grasses, and forbs bordering the Encampment River characterize lower elevations and drainages.

Vegetation in the middle and upper elevations and on rocky slopes is influenced by differing aspects of the canyon, with a mosaic of bunchgrass and small shrubs on steep canyon slopes, and small fingers of trees in draws and gullies. Wildland fires have influenced the vegetation mosaic.

The Encampment River Canyon WSA was studied under Section 202 of FLPMA and was included in the Final Great Divide Resource Area Wilderness EIS filed in August 1990. The BLM Wyoming State Office recommended that all 4,500 acres be designated as wilderness.

Prospect Mountain WSA

The Prospect Mountain WSA includes 1,140 acres of BLM-managed public lands, with no inholdings or split-estate lands. The WSA is located in southern Carbon County, approximately 16 miles southeast of Encampment and 8 miles north of the Colorado-Wyoming border. It is situated along the southwestern flank of the Snowy Range in the Medicine Bow Mountains.

The topography of the area is mountainous, with open sagebrush transitional zones. The WSA contains the western half of Prospect Mountain. Elevations range from 7,400 feet along the North Platte River to 8,500 feet at its southern tip. The WSA is 70 percent forested, with lodgepole pine and aspen as the major species, and contains riparian areas and beaver ponds.

The Prospect Mountain WSA was studied under Section 202 of FLPMA and included in the Final Great Divide Resource Area Wilderness EIS filed in August 1990. The BLM Wyoming State Office recommended that all 1,140 acres be designated as wilderness because the WSA is located adjacent to the USFS Platte River Wilderness.

Bennett Mountains WSA

The Bennett Mountains WSA includes 5,950 acres of BLM-managed public lands, with no inholdings or split-estate lands. The WSA is located in north-central Carbon County, east of Seminole Dam, and lies

about 35 miles northeast of Rawlins. It is part of the Seminoe Mountain range, a small, rugged range that rises abruptly from the surrounding lowlands. The WSA is bounded on the north and east by private and state lands, on the south by a power line road, and on the west by the Bennett Mountain Road.

The Bennett Mountains WSA contains three basic types of topography: mountain plateau/ridges, steep rock ledges, and many tributary draws. Elevations range from 6,600 feet to 7,951 feet. The mountain, which is approximately 4 miles long within the WSA, has distinct ledges and walls along the entire southern exposure. In many places, these walls are vertical outcrops that create the appearance of a fortress. The northern portion is traversed by numerous tree-filled drainages. Most portions of the WSA are vegetated with interspersed grasses, sagebrush, and other shrubs, as well as pockets of pine, aspen, and willows. The higher elevations have considerably less vegetation and more rugged features.

The Bennett Mountains WSA was studied under Section 603 of FLPMA and was included in the Final Great Divide Resource Area Wilderness EIS filed in August 1990. BLM's Wyoming State Office recommended that none of the WSA be designated as wilderness. This decision was based on the relative quality of the area's wilderness values. Although the wilderness inventory notes that outstanding opportunities for solitude and primitive recreation exist in the WSA, these values are not found throughout the study area.

3.13.2 Areas of Critical Environmental Concern

ACECs are managed to protect and prevent irreparable damage to specific resources. This section addresses the specific resources found within each of the existing and potential ACECs identified within the RMPPA.

Existing Areas of Critical Environmental Concern

Currently, there are four ACECs in the RMPPA: Como Bluff ACEC, Sand Hills ACEC, Jep Canyon ACEC, and Shamrock Hills ACEC (Map 2-7). The Jep Canyon, Shamrock Hills, and Como Bluff ACECs are within the checkerboard portion of the RMPPA, which is characterized by public and private ownership of alternating sections of land. This mixed land ownership pattern makes these ACECs difficult to manage, because the owners of private sections may have goals for their lands that are quite different from BLM goals. The mixed land ownership pattern also makes public access to these resources difficult.

Como Bluff ACEC

Como Bluff ACEC protects 1,690 acres of public land, located in the Morrison Geologic Formation (a fossil-bearing formation), for its paleontological resources and historical values. Over the years excavations have removed a wide array of fossilized material, including fossilized bones of dinosaurs such as *Apatosaurus* and *Diplodocus* (Town of Morrison 2002). In addition to the rich collection of paleontological resources, Como Bluff ACEC preserves a portion of the period in American history known as "the Bone Wars." Beginning at Como Bluff in the late 1870s, this period was marked by extremely competitive fossil hunting by paleontologists, including stories of espionage and sabotage (USDI, BLM 2002b). Como Bluff ACEC is part of the Como Bluff Historic District, also known as "the Como Bluff Historic-Paleontologic Site," which is listed on the NRHP (National Register 2002). In addition, the Como Bluff area is an NNL.

Sand Hills ACEC and Proposed JO Ranch Expansion

The Sand Hills ACEC protects about 8,000 acres of public land for its unique vegetation complex, wildlife habitat values, and recreational opportunities. The bitterbrush/big sagebrush plant community, which is interspersed with patches of serviceberry, chokecherry, and aspen and occurs on a deep sand soil, is the only representation of this vegetative mix within the State of Wyoming. This area provides

crucial winter range for mule deer and elk, and nesting and foraging habitat for raptors, greater sage-grouse, and Columbian sharp-tailed grouse populations (Section 3.19).

Recreation in this area is primarily associated with hunting activities. Management actions for the Sand Hills ACEC restrict vehicle traffic to designated roads, reducing potential conflicts between animals and people. In addition, the area is closed to over-the-snow vehicles. The high amount of vehicle use on these vegetation communities and fragile soils has resulted in a high road density (in some areas reaching 9 miles of road per square mile). While there are approximately 9 miles of road per square mile, the majority of these are two-tracks, which limits the amount of traffic in the area.

The proposed JO Ranch expansion, which will occur partly in response to the Pittsburg and Midway Coal Mining Company Exchange, will increase the size of the current Sand Hills ACEC to 12,680 acres. BLM will acquire about 1,200 acres along Cow Creek, which includes the historic JO Ranch and the Rawlins-to-Baggs Freight Road. The JO Ranch is a unique example of continuous ranching activities of over 100 years in the Washakie Basin. This property includes a flood irrigation system along the valley bottom, which has resulted in a very high-quality habitat for wildlife. This system will require maintenance and planning to sustain it for the future. The JO Ranch also served as a stage stop along the Rawlins-to-Baggs Freight Road, a historic route that connected northern Colorado with the Union Pacific Railroad line in Rawlins.

The acquisition of the JO Ranch area will include only the surface rights. The mineral rights will be retained by the current owner, which may limit the potential management actions that can be considered for the property.

Jep Canyon ACEC/Jep Canyon Wildlife Habitat Management Area (WHMA)

The Jep Canyon ACEC protects about 13,810 acres of public land for elk crucial winter range as well as for raptor nesting habitat. There is a Raptor Concentration Area within the boundaries of Jep Canyon ACEC, with a high concentration of raptors including but not limited to red-tailed hawks, Cooper's hawks, golden eagles, and prairie falcons. The high relief topography and wind deposition of snow provide a diversity of vegetation communities, including aspen. Windswept south- and west-facing slopes provide open foraging areas for elk at critical times.

Shamrock Hills ACEC

Shamrock Hills ACEC protects about 18,400 acres of public land for its habitat and productivity of nesting raptor pairs. Shamrock Hills ACEC is recognized as a Raptor Concentration Area, with one of the highest known nesting populations of ferruginous hawks in the United States. These populations are discussed in greater detail in Section 3.19, Wildlife and Fish.

Potential Areas of Critical Environmental Concern

Other areas within the RMPPA that were identified as potential ACECs are described below. These include the Red Rim-Daley Area, Upper Muddy Creek Watershed/Grizzly Area, High Savery Dam, Stratton Sagebrush Steppe Research Area, Chain Lakes Area, Cave Creek Cave Area, Laramie Plains Lake Area, Pennock Mountain WHMA, Wick-Beumee WHMA, Laramie Plains Lakes Area, Blowout Penstemon Area, White-Tailed Prairie Dog Area, and Historic Trails. Each area met at least one of the ACEC relevance and importance criteria necessary to be considered a potential ACEC (USDI, BLM 2004a).

Red Rim-Daley Area

The Red Rim-Daley Potential ACEC (11,100 acres) is a WGFD Cooperative WHMA and is located approximately 15 miles southwest of Rawlins. The Red Rim area contains both the Daley Ranch

allotment and the Daley Ranch Pasture. The area contains scenic values throughout the red sandstone uplift. There are historic carvings in the rocks, with names and dates of people that traveled through the area. The area provides crucial winter range for pronghorn, giving this winter habitat national importance. The area may require additional management to maintain unique scenic and wildlife values.

Upper Muddy Creek Watershed Area

The Upper Muddy Creek Watershed Area includes 127,430 acres. The area contains those portions of the Muddy Creek watershed above the Weber headcut stabilization structure, as well as those portions of the Savery Creek watershed within the Grizzly allotment. The Grizzly allotment is currently managed as a WHMA in cooperation with WGFD. The area contains unique fish habitats that support a rare community of native Colorado River Basin fish, including Colorado River cutthroat trout, bluehead sucker, flannelmouth sucker, roundtail chub, mountain sucker, and speckled dace. Elk crucial winter range is located in this area. The high relief topography and wind deposition of snow provide a diversity of vegetation communities, including aspen (Section 3.15, Vegetation).

High Savery Dam Area

The High Savery Dam and Reservoir area on the Savery Creek drainage south of Rawlins contains 530 acres of public lands, primarily downstream of the dam site. There is an MOU with the Wyoming Water Development Commission (WWDC) to manage the area to protect the dam, reservoir site, and wetland/riparian habitat. Mitigation for wetland/riparian areas impacted by dam construction would result in created wetlands on BLM lands. Public access is closed to vehicular traffic; it is restricted to foot access.

Stratton Sagebrush Steppe Research Area

The Stratton Sagebrush Steppe Research Area is 5,530 acres that includes five small watersheds that have been used for research in the past. Currently, a portion of the Stratton area is withdrawn from locatable mineral entry. There is existing infrastructure that was put in place for past research objectives. Examples of this infrastructure include weirs for measuring stream flows, snow fences, vegetation plot markers, and precipitation gauge sites. The current management allows for grazing on three pastures within the research area, which is part of the Middlewood Hill allotment.

Chain Lakes Area

Management of the Chain Lakes WHMA is coordinated with WGFD by MOUs signed by BLM and the Wyoming Game and Fish Commission (owner of adjacent property in the checkerboard landownership pattern) in 1970 and 1976. The MOU objectives include the use of livestock grazing as a management tool, maintenance of an optimum population of antelope, maintenance of public ownership, administration of the area practically and economically, and discouragement of new fences. The southwestern portion of the WHMA has moderate potential for oil and gas development and currently is being developed in the western portion. The rest of the WHMA has a low potential for oil and gas development (Map 4-7). Locatable mineral potential is low. Different laws, organizational goals and objectives, and management opportunities govern BLM, responsible for public land, and WGFD, responsible for private land.

There are no forestry resources in this area. The Lost Creek Wild Horse Herd Management Area (WHHMA) borders this area to the north, but the WHMA is not within any WHHMA. There is one BLM public access road traversing this area from the southeast to the north-central, the Riner Road. This area encompasses one livestock grazing allotment (Chain Lakes), and is currently used by sheep in the winter.

The Chain Lakes area is located north of I-80, northeast of Wamsutter, and north of Creston Junction. It contains 30,560 acres of public land and occurs in a checkerboard ownership pattern where approximately

54 percent of the lands are either owned or leased by WGFD, and the remaining 46 percent are federal lands administered by the BLM RMPPA. The area contains migration corridors and seasonal ranges for pronghorn, along with raptors, greater sage-grouse, and other wildlife. It also contains a majority of the Chain Lakes, a unique desert alkaline wetland community. Management actions would continue to protect and identify components of the alkaline desert lake system, including historic mud pots and other geologic features and wildlife habitat.

Cave Creek Cave Area

The Cave Creek Cave area is located within the Shirley Mountain SRMA area and contains Cave Creek Cave. Ground water near Cave Creek provides unique humidity and temperature conditions that support hibernating and breeding bats. This cave provides for a hibernaculum and roost site for several bat species, including those on the BLM sensitive species list, because temperatures remain stable and the area is generally undisturbed. In addition to containing unique biological and geological resources, Cave Creek Cave provides unique recreational opportunities for spelunkers, which constitutes the majority of use by people during the late-spring, summer, and fall time period.

Laramie Peak Area

The Laramie Peak area consists of approximately 18,662 acres of BLM-administered land, 11,500 acres of private land owned by the WGFD, and 6,700 acres of state land. There are 20 grazing allotments within the Laramie Peak area, all of which are licensed for cattle grazing. The area is to be assessed as part of the 2006 watershed assessment report for Standards and Guidelines. Ponderosa pine, Douglas fir, lodgepole pine, aspen, mountain shrubs, and grasslands dominate the vegetative communities. The area has steep granitic rock outcrops that drop into flat grasslands and vertical canyons, especially in the Laramie River and Duck Creek drainages.

The area has a wide variety of wildlife species including bighorn sheep, elk, mule deer, antelope, raptors, and fish species such as the hornyhead chub. The area has crucial winter range habitat for bighorn sheep, elk, and mule deer. One of the last remaining populations of the hornyhead chub in Wyoming occurs in this area. The area also contains habitat for the threatened Preble's meadow jumping mouse and potential habitat for Laramie columbine, a BLM sensitive species.

The Laramie Peak area falls within the existing the Laramie Peak Bighorn Sheep Habitat Management Area that directs management of the BLM-administered lands in cooperation and coordination with USFS, WGFD, BLM (both the Rawlins and Casper Field Offices), and public interest groups (such as the Foundation for North American Wild Sheep (FNAWS)). The main objective of the Laramie Peak Habitat Management Area is to restore, improve and enhance habitat conditions for bighorn sheep and other wildlife species. There are 15 site-specific identified projects that are proposed in the Laramie Peak Bighorn Sheep Habitat Management Area. The habitat objectives of these projects are to remove forest canopy and increase grass production in order to improve summer forage, lambing areas and improve movement corridors for bighorn sheep.

Laramie Plains Lakes Area

The Laramie Plains Lakes area is located southwest of Laramie and contains Lake Hattie and Twin Buttes Reservoir as well as 1,600 acres of public land. The area has potential habitat for the endangered Wyoming toad, which is currently found in Mortenson Lake and Moeboer Lake, both located within close proximity. Although this area contains only potential habitat, it is highly possible that the toads can travel through the wetland corridors to Lake Hattie and Twin Buttes Reservoir. Recreationists heavily use this area. Shortgrass species dominate upland areas, whereas wetland areas consist of a combination of emergent aquatic vegetation and bare bank areas.

Blowout Penstemon Area

The Blowout Penstemon area contains 17,050 acres of potential and occupied habitat for the endangered blowout penstemon. This area has increased in size from 4,020 acres in the RMP DEIS to 17,050 acres in the RMP FEIS to incorporate additional populations of the plant found in 2004 through 2006. This area encompasses unique sand dunes that contain steep sandy slopes deposited at the base of granite or sedimentary mountains. The blowout penstemon plant is restricted to sparsely vegetated, early successional shifting sand dunes created by wind erosion. Although some believe the plant is native to Nebraska, historical records show the plant may have been collected during the Hayden expedition in 1877 as it traveled from Casper to Rawlins through Sandy Creek pass and the Seminole Hills (now called “the Ferris Mountains”) (Fertig 2001).

White-Tailed Prairie Dog Area

The white-tailed prairie dog complexes that have been identified within the RMPPA contain eight different colonies and their associated habitat. These complexes, indicated on Map 2-8, include the following areas: Sweetwater, Dad, Shamrock Hills, Pathfinder, Bolton Ranch, Seminoe, Saratoga, and the Shirley Basin-Medicine Bow area.

The white-tailed prairie dog and their complexes are an important element in the sagebrush-steppe ecosystem. The white-tailed prairie dog primarily inhabits open, rolling grassy plains but can also be found in slightly brushy country and in areas with scattered juniper and pinyon pine. The species has been identified as being a “keystone” species—that is, a species on which numerous other species rely as an important component in their life history. At least nine species depend directly on prairie dogs or their activities to some extent, with another 137 species associated opportunistically. Some of these species and the critical components provided to them by prairie dogs include Black-footed ferrets (a federally listed species), which rely on prairie dogs as their primary food source and use their burrows for denning; swift foxes (another listed species), which rely on prairie dogs as a component of their food sources; and burrowing owls, which rely on abandoned prairie dog burrows for nesting (CNE et al. 2003).

Prairie dogs create habitat for themselves and other species by modifying vegetative communities. They create preferential grazing opportunities for herbivores, including livestock, which in turn create opportunities via grazing for the expansion of prairie dog colonies at their perimeters.

Historic Trails (Overland, Cherokee, Rawlins-to-Baggs, and Rawlins-to-Fort Washakie)

Historic transportation routes (i.e., trails, roads, and railroads) command a great amount of management attention because of their overall historic importance in western settlement and expansion and their presence over long distances in the RMPPA. Some of these properties are encountered frequently during cultural resource inventories. The general locations of selected NRHP-eligible linear properties across the RMPPA are shown on Map 2-46.

The Overland Trail

The historic Overland Trail trends east-west through the RFO RMPPA. Blazed for the most part by a combination of emigrant travel to the California gold fields (Lewis Evans and the Cherokee in 1849) and government expeditions (Stansbury and Bryan in 1850 and 1857, respectively), the Overland Trail became the primary central overland route in 1862 (Hafen 1926: 230–31).

Several factors played a role in replacing the familiar Oregon Trail route west to Salt Lake City with the Overland Trail across southern Wyoming. Indian attacks had escalated along the Oregon Trail route (Frederick 1940: 94). The central route was the most economical and expedient; the southern route through the Southwest to the West Coast was longer, and a secondary problem of Southern interference along the route through Texas following the beginning of the Civil War was a consideration as well. Also,

until the 1859 discovery of gold in Colorado, there had been no reason to alter the North Platte route west used by so many emigrants since the end of the fur trade era. The passage of the Overland Mail Bill in March 1861 directed that both Salt Lake City and Denver receive mail on a tri-weekly basis. Therefore, Russell, Majors & Waddell (Central Overland, California, and Pike's Peak Express Company) would provide the service from Missouri to Salt Lake City, and the Butterfield Company, having agreed to a transfer from the southern to the central route, would operate west of Salt Lake City to California. During 1861, the route west from Julesburg, Colorado, continued along the Oregon Trail route to Fort Laramie. After July 1862, the new route bypassed the long loop north over South Pass; instead, the route west from Missouri passed along the South Platte to Julesburg across the Laramie Plains, skirting Elk Mountain, through Bridger Pass, and across Green River to Fort Bridger (Bartlett 1918: 333; Hafen 1926: 213–218; Beard 1933: 119–122).

In July 1862, following the Federal Government's decision to relocate the U.S. Mail service from the established emigrant route, Fort Halleck was constructed along the Overland Trail at the northern base of Elk Mountain to protect the new stage route from Indian depredations (Bryan, 1857: 46; Hafen 1926: 230–231, 242, 248; Erb et al. 1989: 50–51). Winters in the region could be severe, and timber obtained from nearby Elk Mountain was used to build the post and for firewood. Coal from outcrops north of Fort Halleck was used for blacksmithing and to supplement the wood supply for heat. On February 24, 1864, the post physician, Dr. John H. Finfrock, wrote in his diary that troops obtained a wagonload of coal from a location north of the fort; known coal resources lay exposed only a few miles away (Finfrock 1864).

The Overland Trail remained in use until 1869, when the Union Pacific Railroad (UP) was completed across southern Wyoming; subsequently, the federal mail and passenger service was transferred to the railroad. The Overland Trail, however, remained in use as a thoroughfare for emigrant and freight traffic, becoming the trunk line for the late 19th-century road system that developed in the region south of the UP rail line that served the towns and outlying ranches (Holt 1885).

Only three of the stage stations built along the trail exist on currently administered public lands: the Midway, Sage Creek, and Washakie Stations. The Washakie Station is listed on the NRHP and still retains some of the original structure. The other two stage stations have been destroyed, although their location is well documented. Evidence of the trail remains in the form of ruts and swales as well as associated artifacts.

The Cherokee Trail

The California gold rush was the catalyst for the Cherokee Trail, the northern route of which would become the precursor of an overland wagon road across the southern portion of future Wyoming Territory. In 1849, Lewis Evans led a party of Cherokee Indians from Oklahoma to the California gold fields. The Cherokee Trail connected Bent's Old Fort on the Santa Fe Trail to Fort Bridger on the Oregon-California Trail (Homsher 1965: 4; Whiteley 1999: 2–3).

In 1849, Lewis Evans led a party of Cherokee Indians from Oklahoma to the California gold fields. From the South Platte River, they headed north along the east side of the Front Range, passing over the future route of Highway 287 to Virginia Dale and Tie Siding and onto the Laramie Plains. They proceeded west around the north end of the Medicine Bow Mountains, then south of Elk Mountain through Pass Creek, and continued west well north of Bridger's Pass and across the Red Desert on their way to Fort Bridger (Fletcher, Fletcher, and Whiteley 2000: 107–119; Whiteley 1999: 8–9, 16–18, 94, 96–97).

In 1850, several parties of Cherokee followed the 1849 route to the southern Laramie Plains, then headed west across the southern portion of the Medicine Bow Mountains, crossing the Laramie River south of future Woods Land and passing into North Park, Colorado, where they crossed the North Platte River then headed north along the east flank of the Sierra Madre Mountains. They crossed the Continental Divide at Twin Groves near the north end of the Sierra Madre and proceeded west along the Wyoming-Colorado border north of the Little Snake River (Fletcher, Fletcher, and Whiteley 2000: 313–338; Whiteley 1999: 8–9, 95, 114–115).

Today, evidence of the Cherokee Trail is scarce, but it can be found in the form of ruts and swales.

The Rawlins-to-Baggs Freight Road

The Rawlins-to-Baggs Freight Road is listed as eligible for the NRHP. General Land Office plats dating from 1881 to 1917 (surveys and resurveys) refer to the route as the Rawlins-to-White River Road (1881), and the Rawlins and the Snake River Road (1881), and the Baggs-to-Rawlins Road (1916). The origins of the route lie in two historic events: (1) the building of the first transcontinental railroad through southern Wyoming Territory in 1867–1868 and the consequent founding of the town of Rawlins, and (2) the creation of the White River Agency for the Ute Indians in northwestern Colorado in 1868.

Rawlins grew up along the Union Pacific Railroad right-of-way near a free-flowing spring. Chief Engineer Grenville Dodge named the spring and railroad station after his good friend Major General John A. Rawlins, a noted military figure who had been General Grant's chief of staff and a secretary of war. Other sources claim that the springs were named after an early trapper known as "Rawlins" or "Rawlings."

At the same time in Colorado Territory to the south, events were leading to the creation of a reservation and agency for the Ute Indians, whose nearest supply point would become Rawlins and the Union Pacific Railroad. In 1868, the Federal Government negotiated a treaty that created a large reservation comprising the western third of Colorado Territory for the Utes, who were gradually being forced westward by white encroachment along the eastern slope of the Rockies. Under the new treaty, two agencies were created to disburse annual gifts of clothing, food, and supplies. The White River Agency was located on the White River (near present-day Meeker, CO) for the use of the northern Ute bands (Ubbelohde, Benson, and Smith 1972).

The stage and freight route that developed from Rawlins to the Ute Agency headed southwest from Rawlins and skirted the western base of the Sierra Madre Range. The road crossed the east-west Overland Trail at Sulphur Springs, a "home" station for Holladay's route. It also crossed the old Cherokee Trail and continued south, following Muddy Creek to the Snake River Valley and crossing into Colorado (Rankin 1944). The route was first used for freight, but mail and passenger service was added as the region became more settled.

Stage service ended on the Rawlins-to-Baggs Road in 1909. Rail service was slow in coming to the area of northwestern Colorado that was served by the Rawlins-to-Baggs Road and its extension to White River (through Craig to Meeker, Colorado). The Denver and Rio Grande Railroad built to the west from Glenwood Springs to Rifle in 1889, some 40 miles to the south. The Denver, Northwestern and Pacific Railroad built to Steamboat Springs in 1908, and its successor, the Denver and Salt Lake Railroad, extended its trackage in 1903 to Craig, more than forty miles south of Baggs (Wilkins 1974). Therefore, Baggs and the surrounding ranches in the Little Snake River Valley and to the north remained tied to the Rawlins-to-Baggs Road well into the 20th century.

The Rawlins-to-Baggs freight road parallels the 20-mile road out of Rawlins. Portions of the road are in excellent condition, with deep swales and ruts present.

The Rawlins-to-Fort Washakie Freight Road

The Rawlins-to-Fort Washakie Freight Road was originally laid out and used as a trail by the military after the establishment of Camp Auger, probably in 1868 or 1870. The trail was extended 16 miles northwest to Fort Washakie in 1871, when the Indian Agency was established there. At this time, travelers from the Union Pacific Railroad mainline reached Lander and Fort Washakie by means of a stage route from Green River City via South Pass.

Although stage travel throughout the 1870s and early 1880s used the Green River City-to-South Pass route, the Rawlins-to-Fort Washakie Trail laid out by the military appeared on Masi's Black Hills Map (1875), and the road, as well as a telegraph line, appeared on General Land Office plats dated 1882. In

1884, the town of Lander was officially platted. As the settlement grew, the need for stage service arose, and in 1885, L.L. Slavens instituted a tri-weekly stage service from Rawlins to Lander and Fort Washakie, using the original military trail.

The Rawlins-to-Fort Washakie Freight Road represented the key transportation link between Wind River Valley and the Union Pacific Railroad through southern Wyoming Territory. The establishment of the road set the pattern of transportation, communication, and settlement for the Wind River Valley from the south via Rawlins.

Stage service on the route ceased on June 30, 1906. With the rapid approach of rail service to Lander from the east, the route was no longer needed to serve the Wind River Valley and the Indian Agency. It is not known how long the telegraph line was kept in use. The Rawlins-to-Fort Washakie Freight Road undoubtedly was used by freight and local ranch traffic well into the 20th century, when the modern highway was constructed over Muddy Gap to the east.

Other Management Areas

Pennock Mountain Wildlife Habitat Management Area

WGFD first established the 9,806-acre Pennock Mountain Elk Winter Range, located east of Saratoga, in 1962. The area contains crucial winter habitat for both elk and mule deer. BLM reserves all grazing preference for wildlife on 6,284 acres of BLM-administered public land, including 1,530 AUMs of forage for wintering elk. This area is closed to human presence and motorized vehicle use, including over-the-snow vehicles, from November 15 through April 30. The area contains mountain big sage, mountain shrub, aspen, cottonwood, and willow habitats.

Wick-Beumee Wildlife Habitat Management Area

WGFD established the Wick Elk Winter Area, located on both sides of I-80 and between the towns of Elk Mountain and Arlington, in 1965. The area contains elk winter/crucial winter range and year-round habitat for wildlife. In conjunction with WGFD's purchase of the Wick Brothers Ranch, an MOU between BLM and WGFD was developed that reserves grazing use on the 280 acres of BLM-administered public land for elk and other wildlife. The terrain ranges from rugged foothills in the south to gently rolling plains in the north. Vegetative communities consist of sagebrush, mountain shrub, and aspen. The area is closed to human presence and motorized vehicle use, including over-the-snow vehicles, from November 16 through May 31.

Cow Butte/Wild Cow Area

The Cow Butte/Wild Cow area, located between Rawlins and Baggs, was developed to promote management of upland and riparian habitats for wildlife and other multiple-uses. It encompasses 63,697 acres of mostly BLM-administered public land (49,570), along with 4,768 acres of private land and 8,697 acres of state land, and it borders the Upper Muddy Creek Watershed area to the north and the Sand Hills ACEC to the northwest. Of special concern in the area are the steep slopes and gullies that have the potential to accelerate erosion that would lead to increased habitat degradation. The moderate and steep slopes on south and west aspects are the principal areas used by elk during critical winter periods. This area encompasses a significant portion of elk crucial winter range. Impediments to wildlife movements from existing fences and habitat fragmentation have resulted in a loss of usable elk crucial winter range.

The area has a combination of diverse upland habitat conditions intertwined with perennial and ephemeral stream systems and riparian habitat, which combine to support an abundance of wildlife species, including elk, mule deer, pronghorn, greater sage-grouse, sharp-tailed grouse, and raptors. The most important factor of the area is the mosaic mix of these wildlife habitats resulting from the diversity of plant communities, topography, soils, and climate. Vegetation communities within this area include

aspen, four types of sagebrush, mountain shrub, and riparian/wetland communities which provide for the array of habitat.

There are seven different grazing allotments either wholly or partially contained within the area, including that portion of the Grizzly allotment that lies outside the upper Muddy Creek watershed. The WGFD established the 38,091-acre Grizzly Habitat Management Area in 1992. In conjunction with the acquisition of the Grizzly allotment, an MOU, habitat management plan, and allotment management plan were developed between the WGFD and BLM to guide management of aquatic and terrestrial wildlife and fisheries habitat.

Prior to and during this same time span, BLM, permittees, and the Little Snake River Conservation District have worked on adjoining allotments to implement a variety of actions to improve watershed and vegetation condition. These include pasture fencing and water developments to manipulate livestock grazing, road improvements to reduce sediment delivery into streams, and prescribed burns to improve upland shrub habitat and herbaceous production. These actions have all helped to improve riparian and upland habitat conditions; however, upland plant community health and modification of fences for wildlife benefit still remain management priorities for this area.

3.13.3 National Natural Landmarks Management

NNLs include Big Hollow, which contains 640 acres of public land; Sand Creek, which contains 160 acres of public land; and Como Bluff, which contains 1,690 acres of public land.

Big Hollow, which was designated an NNL in 1980, is characterized by a large depression or deflation basin formed by wind erosion. This NNL on the high plains west of Laramie contains 640 acres of public land to which legal access does not exist.

The significance of the Big Hollow NNL lies in the great size of the deflation basin and the Aeolian processes through which it was formed. The deflation basin is considered the largest topographic feature of its kind in the continental United States. The integrity of the surface of those portions of the deflation basin that have not been disturbed enhances the naturalness of the landmark.

The Sand Creek NNL was designated in 1984, primarily for its scenic values and for the scientific values of its geologic features. It is about 20 miles southwest of Laramie and contains 160 acres of public land to which legal access does not exist. Land use within this area is predominantly livestock grazing.

The geologic features at Sand Creek include pillars and monuments of cross-bedded sandstone. Chimney (Camel) Rock is more than 200 feet high. To the west of these features, a sandstone escarpment rises as much as 300 feet above the surrounding terrain. The red and white coloring of the wind- and water-sculpted features adds to the scenic beauty of this natural landmark.

A description of the Como Bluff NNL is provided above in the ACEC section.

3.13.4 Wild and Scenic Rivers

There are currently no designated Wild and Scenic Rivers (WSR) in the RMPPA. The portion of the Encampment River within the WSA is the only segment in the RMPPA that has been identified as eligible and suitable for WSR designation, which requires congressional approval. Designation of the WSR would ensure continued protection of the outstandingly remarkable character of the river corridor for future generations.

BLM-administered public land surfaces (public lands) along 402 waterways in the RMPPA were reviewed for WSR eligibility. In 2002, public lands along 393 of these waterways were found not to meet the eligibility criteria and were dropped from further consideration (Appendix 3). Public lands along nine waterways were determined to meet the eligibility criteria and are described as follows:

Big Creek

The segment of Big Creek reviewed is 7.72 miles long, of which 3.39 miles flows through three public land parcels determined to meet the WSR eligibility criteria. The outstandingly remarkable values (ORV) for these parcels were determined to be recreational values. The public lands reviewed attract visitors from outside the area to enjoy fishing, hunting, and picnicking.

Bunker Draw

The entire length of the segment of Bunker Draw reviewed is 0.15 miles long and flows through one public land parcel and contains scenic ORVs. This public land parcel includes a deeply incised canyon unique to the region. The maples and cottonwoods on public lands in the waterway corridor add to the scenic quality, especially during the fall.

Cherry Creek

The segment of Cherry Creek reviewed is 5.40 miles long, of which the creek flows through one public land parcel and contains ecological ORVs. The upper section is located in the Ferris Mountain WSA. Through implementation of appropriate range management standards, this public land parcel includes one of the most pristine creeks in the Ferris Mountains and is used as an ideal or “showcase” example for proper range management techniques.

Duck Creek

The segment of Duck Creek reviewed is 3.25 miles long, of which 2.97 miles of the creek flows through two public land parcels and contains scenic ORVs. Located within the review segment is a 35-foot waterfall that is unique to the area and has a scenic quality that has the potential to attract visitors from outside the area.

Encampment River

The segment of the Encampment River reviewed is 2.51 miles long and flows through the Encampment River WSA, which includes one public land parcel and contains scenic, recreational, historical, and wildlife ORVs. This public land parcel includes a rugged canyon with colorful rock outcroppings and thick riparian vegetation. The river is considered a “Class 2” stream (very good trout water of statewide importance), as designated by WGFD, that attracts anglers from outside the region. The public lands also provide hiking and horseback riding opportunities. A public campground is located directly downstream from the review segment and provides easy public access to the waterway segment under review. Public lands within the river corridor are also associated with historic copper mining operations and tie hacking, an old flume, and mining-associated sites (e.g., prospector pits, shafts, adits, mining cabins). The public lands also include important bighorn sheep lambing grounds along the steep canyon walls above the river.

Littlefield Creek

The segment of Littlefield Creek reviewed is 4.58 miles long and contains fisheries and ecological ORVs. This public land parcel includes habitat of exceptionally high quality for the Colorado River cutthroat trout. There is historical documentation of the species existing in the creek during Jim Bridger’s time (i.e., the 1850s). BLM and WGFD have been using the public lands for reintroduction of the Colorado River cutthroat trout since September 2001. The success of these efforts is assured because of the use of artificial barriers that deter competitive fish species. This is the only population of Colorado River cutthroat trout in the entire watershed and is unique because other populations are in forested headwater streams. The public lands also include one of the few intact dogwood/birch communities in the area.

Muddy Creek

The entire length (87.50 miles) of Muddy Creek was reviewed, of which 34.96 miles of the creek flow through 47 public land parcels and contain hydrological ORVs. These public land parcels provide a “textbook” example of stream rehabilitation that is used as a demonstration for managers and educators.

North Platte River

The segment of the North Platte River reviewed is 5.22 miles long, of which 4.59 miles flow through two public land parcels and contains scenic, recreational, and wildlife ORVs. These public land parcels include a beautiful, steep canyon unique to the area. The segment of waterway reviewed has been designated by WGFD as a Blue Ribbon trout fishery and attracts anglers from across the nation. The review segment is also boated extensively. BLM offers two campsites on public lands that provide important boat access for recreationists. A trail system on public lands also offers hiking opportunities. The public lands provide important winter and nesting habitat for bald eagles.

Skull Creek (Including Short Segment of Two Unnamed Tributaries)

The segment of Skull Creek reviewed is 11.75 miles long. The main branch of the unnamed tributary reviewed (Tributary A) is 6.99 miles long, and the second unnamed tributary reviewed (Tributary B) is 6.01 miles long. The Skull Creek unit flows through the Adobe Town WSA, which includes one public land parcel determined to meet the WSR eligibility requirements. The unnamed tributaries flow through the same public land parcel for a total of 13.00 miles when combined. The Skull Creek unit, Tributary A, and Tributary B contain scenic and paleontological ORVs. The Skull Creek unit traverses badland topography, with hoodoos and interesting mud ball formations in the waterway corridor. A well-known vertebrate fossil study area is also located on public lands where large amounts of fossil fish, turtles, and other animals are exposed by streambed erosion.

3.13.5 Other Management Areas

Rawlins-to-Baggs Geographical Area

The Rawlins-to-Baggs area is bounded on the north by I-80, on the east by State Highway 71 and Carbon County Road 401, on the south by State Highway 70, and on the west by State Highway 789. This area contains unique and valuable vegetation and wildlife resources that require special management emphasis. The natural resources within the area draw a high number of dispersed recreationists. Mineral development in this area has high potential, and if this development were to take place, it is likely that the values of this area would be compromised.

The Rawlins-to-Baggs area has a combination of diverse upland habitat conditions intertwined with perennial and ephemeral stream systems and riparian habitat, which combine to support a higher than normal wildlife species richness. The most important factor of the area is the mosaic mix of these wildlife communities in close proximity to one another based upon the diversity of topography, soils, and climate. Vegetation communities within this area include aspen, six types of sagebrush, juniper, mountain shrub, saline desert shrub, and riparian/wetland communities.

South-central Wyoming is a unique area within the contiguous United States and contains vast tracts of undisturbed wildlife habitat. There is an abundance and richness of wildlife that includes big game, raptors, greater sage-grouse and Columbian sharp-tailed grouse, Neotropical birds, Colorado River cutthroat trout, and BLM sensitive warmwater fish species. This diversity is also observed in the proximity of seasonal ranges to crucial winter ranges; the overlapping winter ranges of several big game species; and important birthing areas for antelope, mule deer, and elk. Raptor species include a wide variety of hawks, eagles, and owls as well as healthy populations of two BLM state sensitive species—

ferruginous hawks and burrowing owls. This area is the only place in Wyoming where Columbian sharp-tailed grouse occur, and their range is expanding northward. There are few locations elsewhere in Wyoming that support a higher density of greater sage-grouse.

The upper Muddy Creek drainage bisects the middle of this region, and it once supported Colorado River cutthroat trout in the days when Jim Bridger first explored routes for the settlers that followed. Active management of both fish communities and habitats has recently culminated in the reintroduction of Colorado River cutthroat trout to the upper watershed. These management activities have included the management of livestock grazing to improve riparian conditions as well as the removal of exotic fishes. By improving habitat conditions and removing exotic species that compete with or hybridize with native fishes, these actions have benefited a rare relict native fish community including both coldwater (i.e., Colorado River cutthroat trout and mountain sucker) and warmwater (i.e., bluehead sucker, flannelmouth sucker, roundtail chub and speckled dace) native fishes. Continued focus of fisheries management activities within the upper Muddy Creek watershed may benefit this rare relict native fish community sufficiently to preclude the need to list these species for additional protection under the Endangered Species Act (ESA).

The plant and wildlife values of this area are reflected in several smaller portions being proposed as SD/MAs including the proposed Upper Muddy Creek Watershed/Grizzly Potential ACEC, Red Rim-Daley Potential ACEC, Jep Canyon ACEC (elk and raptors), and Sand Hills ACEC (mule deer). However, piecemeal protection of the higher value areas will not adequately protect all the wildlife species that use and depend on this area.

The Rawlins-to-Baggs area is a popular dispersed recreation destination, particularly for hunters, because here they can hunt multiple big game species. There is a sufficient road network for recreational access, and the scenic quality of the area is not impaired by an abundance of permanent facilities.

The Continental Divide National Scenic Trail passes through this area. Visitation to the trail is gradually increasing.

Cultural values in this area include the Overland and Cherokee Historic Trails, the Rawlins-to-Baggs Freight Road, the historic JO Ranch, and numerous other significant cultural properties. The historic trails and roads are important reminders of settlement in this area.

The Rawlins-to-Baggs area also includes the Historic Trails Potential ACEC, High Savery Dam Potential ACEC, and Continental Divide National Scenic Trail SRMA.

3.14 TRANSPORTATION AND ACCESS

Transportation activity within the RMPPA is associated with a variety of resource uses, including mineral extraction, livestock grazing, and recreation. The level of access to these resources can affect their potential levels of use. This section addresses the current roadway network, access issues, and trends associated with the RMPPA transportation system.

3.14.1 Roadway Network

The RMPPA roadway network includes a spectrum of roads for varying purposes. Map 1-4 shows the interstate transportation network, U.S. and state highways, and county roads. There are two interstate highways through the RMPPA: I-25, which runs north-south through Cheyenne and Wheatland in the far eastern part of the area; and I-80, running westward from Nebraska to generally bisect the RMPPA. For the most part, U.S. highways are co-located on interstate highways, with U.S. 87 following I-25 and U.S. 30 following I-80. An important exception is the divergence of U.S. 30 from I-80 between Laramie and Walscott, where it is co-located with U.S. 287. This route is less subject to the blizzard conditions that sometimes occur in this segment of I-80. As would be expected on the basis of population, state highways are much more numerous in the portion of the RMPPA east of Rawlins. West of Rawlins, State Highway 789 is the only state highway, and other routes are typically unpaved.

Not shown on Map 1-4 are numerous smaller roads laced throughout the RMPPA, which connect more remote locations within the RMPPA to the larger collector roads. These roads are used for recreational purposes, to provide access for the development and maintenance of oil and gas wells, and for range management improvements. Most of these roads are not paved; they are of dirt, gravel, or sand. These roads include those that are maintained by BLM, by counties, and by private corporations. The larger collector roads shown on Map 1-4 are not maintained by BLM.

Access

The checkerboard land ownership pattern and other non-BLM-managed inholdings create problems for accessing land and resources administered by BLM. Some easements exist to allow access across private lands to public lands, but there are several locations where public access to public land is not available due to the lack of such easements or contiguous BLM-managed public land. For example, access to the Overland Trail is hampered because of noncontiguous BLM-managed land. In addition, public access to streams and reservoirs is often restricted by the absence of lands with legal public access adjacent to the water.

Transportation Trends

Energy- and recreation-related vehicular traffic on the public lands is increasing. This is due to further energy development and recreational use by the general public. With the greater use and demand on the existing transportation network, additional legal access would be required to provide for and enhance travel to and from the public lands.

3.15 VEGETATION

Vegetation resources within the RMPPA are diverse and in some areas unique. The precipitation, elevation, and temperature extremes, combined with soil and geology variability, create a variety of vegetation habitat types. The eastern areas of the RMPPA, located in Wyoming's southeast corner, are within the vast North American prairies, where mixed-grass communities dominate. The desert areas provide habitat for a variety of hearty plants tolerant of low precipitation, temperature extremes, and saline soils. High elevation areas on Elk Mountain and the Seminoe and Ferris Mountains support plants adapted to very low temperatures, an extremely short growing season, and high snow accumulation. Since the RMPPA straddles the Continental Divide in the gap between the Northern and Central Rocky Mountains, it tends to support a mixture of plains and intermountain plant species, with wind and climate factoring strongly into the evolution of local plant communities. Bison and their grazing influence upon vegetation were another important component of community evolution. Fremont in 1842 and Stansbury in 1850 referenced the occurrence and common sign of bison in this area, and Native American kill sites of this animal are documented in numerous locations.

The RMPPA supports a variety of vegetation types, each of which is susceptible to fire occurrence as a result of fuel loading or as a natural condition of the environment. Vegetation treatments in the RMPPA operate under the protocols set forth in the Vegetation Treatment on BLM Lands in Thirteen Western States Final Environmental Impact Statement and Record of Decision (USDI, BLM 1991b). Vegetation treatments include fuels reduction, vegetation health, and weed control projects, with separate annual treatment acreages for each.

This discussion focuses on vegetation distribution and vegetation types at three levels. The top level divides the RMPPA into three vegetation provinces. These were taken from Bailey (1995), who describes the ecoregions of the United States. The middle level uses vegetation map zones aggregated from Geographical Analysis Program (GAP) satellite imagery interpretation. The map zones allow quantitative measurements of broad vegetation types. The lowest level describes the individual plant communities, defined by the soil, climate, and vegetation characteristics. Each level may be used as a management tool depending on the specific issues and level of detail required. Wetland, riparian, and upland plant species commonly found in the RMPPA are presented in Appendix 28.

3.15.1 Ecological Provinces

Bailey's (1995) description of North American ecoregions places the RMPPA in three different vegetation provinces. These include the Intermountain Semi-Desert Province (342), Great Plains Dry Steppe Province (331), and Southern Rocky Mountain Steppe—Open Woodland—Coniferous Forest Province (M331). The following subsections provide an overview of each of these vegetation provinces.

Intermountain Semi-Desert Province (342)

The Intermountain Semi-Desert Province is contained within the intermountain basins of Wyoming and northern Colorado. The chief vegetation type, sagebrush steppe, is made up of sagebrush, saltbush, and a mixture of grasses and forbs. Willows, rushes, and sedges dominate the wetter valley bottoms, while greasewood and inland saltgrass dominate drier streams and ephemeral washes (Bailey 1995; Knight 1994). The higher elevations may contain pockets of aspen in the wetter areas and juniper/limber pine stands in the drier areas.

This area is sometimes considered a cold desert, as the summers are hot and the winters can be extremely cold. The growing season is short (Rawlins has a frost-free period of 106 days), and the annual precipitation varies between 5 and 14 inches. Annual snowfall averages between 20 and 60 inches (Martner 1986). Winter snow accumulation and runoff provide available moisture for spring plant growth.

Snow distribution patterns caused by wind, topography, and existing vegetation function to develop pockets of highly productive sites within the drier, less productive surrounding areas.

This area lies predominantly in the western and central regions of the RMPPA, at elevations below 8,000 feet. Forest and alpine areas dissect this vegetation province; these areas provide winter habitat for many wildlife species. Livestock and wildlife grazing are the primary uses of the area.

Great Plains Dry Steppe Province (331)

Mixed- and shortgrass prairies east of the central Rocky Mountains dominate the Great Plains Dry Steppe Province. Typical grasses in these areas include buffalo grass, grama grasses, wheatgrasses, and needle grasses. Deeper soils in wetter areas may grow taller grasses, such as Indian grass and little bluestem. Scattered shrub colonies may dot the landscape with big sagebrush, sand sagebrush, and rabbitbrush. Wet riparian areas provide habitat for cottonwood, sumac, willow, and alder (Bailey 1995; Knight 1994).

This area lies in the rain shadow of the Rocky Mountains. Winters are cold and dry, and summers are warm, with frequent thunderstorms (Martner 1986; Bailey 1995). Cheyenne has a moderate growing season of 138 days, but Laramie, 40 miles west, has a much shorter growing season of only 93 days. The annual precipitation of the area is between 10 inches in the far west and 16 inches east of Cheyenne. The average annual snowfall is between 60 and 80 inches (Martner 1986).

Within the RMPPA, the Great Plains Dry Steppe Province dominates the ecology of the Laramie Basin and the prairie east of the Laramie Range to Nebraska. The Laramie Basin varies in elevation between 7,000 feet and 7,500 feet, whereas the elevation of the far southeast portion of the RMPPA ranges between 5,500 feet and 7,000 feet. Most of this area is privately owned and is used for grazing of livestock, irrigated cropland, or dryland farming.

Southern Rocky Mountain Steppe—Open Woodland—Coniferous Forest Province (M331)

The Southern Rocky Mountain Steppe—Open Woodland—Coniferous Forest Province is a transition from grass- and shrub-dominated areas to shrub- and tree-dominated areas. Brome and fescue grasses, mountain mahogany, sagebrush, aspen, and juniper dominate the 8,000-to-9,000-foot elevations. The middle elevations of pine and spruce forest lie between 8,500 feet and 12,000 feet. Alpine tundra occurs only in the RMPPA area above 10,000 feet and is dominated by short grasses and cushion-type forbs, as well as by krummholz patches of spruce and fir. Riparian vegetation also varies according to elevation; however, willows and water-tolerant grasses, sedges, and rushes often dominate from the foothills to the alpine (Bailey 1995; Knight 1994).

The climate of these areas is very variable and dynamic as a result of factors such as elevation, aspect, slope, and topographical change. Eastern and southern slopes are generally drier and warmer than are western and northern slopes. As the elevation rises, the mean temperature drops and the growing season shortens. (Fox Park, at 9,065 feet, has a frost-free period of only 21 days.) Annual precipitation generally increases from 14 inches in the foothills to over 60 inches in the alpine area. Winter mountain snowpack may reach over 200 inches per year and provides a reservoir for lower elevation water users (Martner 1986; Knight 1994).

Mountain ranges dominated by the Southern Rocky Mountain Steppe—Open Woodland—Coniferous Forest Province are well distributed throughout the RMPPA. They include the Snowy Range, the Sierra Madre, the Laramie Range, the Shirley Mountains, the Freeze Out Mountains, the Seminoe Mountains, and the Ferris Mountains. These areas provide summer forage for wildlife and livestock as well as important habitat for many nongame mammals, birds, and fish. Higher elevation provides areas of increased diversity and productivity within large areas of lower precipitation and often harsher environments.

3.15.2 General Vegetation Map Zones

The general vegetation zones illustrated in Map 3-10 represent combinations of plant community classes taken directly from the Geographical Analysis Program (GAP) satellite imagery analysis. The classes combined for each zone, the zone's total area, the dominant vegetation, and a description of the area where the vegetation occurs are also provided. Note that the percentages indicated represent total area within the RMPPA, some of which is owned by private, state, or other federal entities.

Distinct plant communities within the RMPPA are influenced by characteristics such as soil depth, texture, and salt content; climate variables, particularly temperature, total and seasonal distribution of precipitation, and wind; and topographic features, most importantly elevation, aspect, and slope. Plant communities respond to other environmental influences such as wildlife foraging, rodent burrowing, and ant hills.

Plants themselves also influence soil chemistry and soil resistance to wind and water erosion. The following plant community overviews explain the diverse and complex nature of vegetation communities in the RMPPA.

Agriculture/Town (9 Percent)

This highly modified vegetation zone is mapped within the RMPPA. It includes areas that are settled, farmed with or without irrigation, or mined. It also includes areas mapped by GAP as forest-dominated riparian that in reality are primarily hayfields with only linear cottonwood stands remaining. With the exception of mined areas, little or none of this vegetation zone occurs on land managed by BLM.

Barren (2 Percent)

The barren vegetation zone occurs in diverse locations, all of which are inhospitable to vegetation. These locations range from exposed areas on mountaintops, to rocky outcrops and granite rockpiles, to basin soils, such as sand dunes and badlands, that do not support plants for various reasons. This zone also includes areas mapped as open water that are primarily large deep reservoirs not supporting plant life.

Forest and Woodland Communities

Broadleaf Communities (2 Percent)—Aspen

Quaking aspen communities in the RMPPA occupy the transitional zones between the sagebrush-dominated communities and the coniferous forests. Aspen are also present along streams, in draws, or on the leeward areas of hills and ridges where snow collects. Aspen colonies typically reproduce asexually, producing clones in which separate trees are connected by root suckers. Therefore, several acres of aspen may be interconnected through their roots (Barns 1966). The soils of these areas are usually well-developed deep loam and sandy loam soils with good drainage and high organic matter.

Acting as snow traps, aspen stands are able to support higher productivity and more diverse herbaceous plants than are the adjacent coniferous or sagebrush communities. Aspen stands also provide protective cover essential to mountain watersheds. Understory plants commonly include mountain brome, lupine, columbine, Indian paintbrush, elk sedge, Columbia needlegrass, Kentucky bluegrass, wildrye, licorice-root, elkweed, bedstraw, yarrow, bluebells, yampah, fairy bells, arnica, snowberry, serviceberry, Oregon grape, wood rose, Scouler's willow, and common juniper.

Aspen respond well to fire, and fires typically stimulate repressed colonies to increase root sucker regeneration. This may diversify the age structure of the stand and increase herbaceous production. The occurrence of spring and fall fires has produced the best results.

Wildlife use aspen in the fall, winter, and spring for both cover and forage. The open cover of aspen stands provides mule deer fawning areas and elk calving areas. High forb and grass production as well as shade draw wildlife and cattle into these areas during summer grazing seasons. Birds use these areas for important nesting sites, and other nongame species also rely on this habitat. Lower elevation aspen stands at edges of sagebrush are important areas of wildlife biodiversity for many small birds, raptors, and owls. A diversity of age classes and stand densities is important in maintaining diverse wildlife communities supported by aspen.

River bottom cottonwood forests occur along the North Platte River bottom and are dominated by plains cottonwood and narrowleaf cottonwood. The vegetation type is very similar to riparian woodlands; however, these areas are drier and usually have a natural understory dominated by upland grasses and forbs in areas where agriculture is absent.

Conifer Communities

Juniper (1 Percent)

Juniper woodlands in the Colorado River watershed area often have Utah juniper as the single tree species. These sites occur on rocky, fractured bedrock areas at elevations between 5,700 and 7,500 feet, with annual precipitation between 10 and 15 inches. In other areas, on foot-slopes adjacent to conifer forests, Rocky Mountain juniper occurs in association with limber pine. These sites may occur in association with basin and mountain big sagebrush steppe in shallow, poorly developed soils at elevations between 7,500 and 8,500 feet. Annual precipitation in these areas is between 16 and 20 inches. Both types of juniper woodlands have understory vegetation that may include bluebunch wheatgrass, needle-and-thread, slender wheatgrass, Idaho fescue, Wyoming big sagebrush, mountain big sagebrush, snowberry, mountain mahogany, bitterbrush, and common juniper.

Juniper-dominated communities often become decadent because the dominant species pumps most of the soil water into the atmosphere, resulting in a monoculture of juniper. At this point, prescribed fire in these areas does not result in an effective burn, because the fine fuels on the ground do not carry the fire into the trees. However, when these communities do eventually burn, they may sustain dangerous high-intensity wildland fire during high winds in the hot season. After juniper woodlands burn, production of herbaceous vegetation responds very well.

Other Conifer (10 Percent)

Limber Pine Woodland

Limber pine is the dominant tree on rocky escarpments surrounded by more productive grasslands (Knight 1994). It may also occur as a subdominant tree in juniper woodland, as mentioned above. Limber pine-dominated areas are normally associated with Idaho fescue, bluebunch wheatgrass, globemallow, phlox, sand sage, fringed sage, snowberry, and mountain big sagebrush.

Lodgepole Pine Forest

The most common tree in the mountains of northern Colorado, Wyoming, and much of the Northern Rockies is lodgepole pine. These forests occur in the middle elevations of the area mountain ranges, between 8,000 and 10,000 feet (Knight 1994). Lodgepole pine is considered a pioneer species, as it returns rather quickly following fire and does not regenerate well in a continuously shaded environment. These trees also produce serotinous cones, which are more likely to release their seeds and germinate following intense heat.

The lodgepole pine forest canopy does not allow for a very diverse understory plant community. Plants that occur here are pine reedgrass, Wheeler bluegrass, heartleaf arnica, bedstraw, wortleberry, common

juniper, wood rose, wax currant, and russet buffalo berry. Lodgepole pine will grow in mixed stands of aspen, Englemann spruce, subalpine fir, Douglas fir, and Ponderosa pine (Knight 1994).

Lodgepole pine forests are present in many mountain areas of the RMPPA and are managed for wildlife habitat, watershed maintenance, and timber production. A detailed discussion of the management of these areas is included in Section 3.5, Forest Management.

Ponderosa Pine Forest

Ponderosa pine occurs at lower elevations on the eastern slopes of mountains, where summer precipitation levels may be higher and the growing season is longer and warmer. The most notable stands of ponderosa pine in the RMPPA are on the eastern slopes of the Laramie Range, Shirley Mountains, and Seminoe Mountains. Ponderosa pine forests are often open woodlands and support a mixed-grass or shortgrass understory.

Scattered Upper-Elevation Species

Scattered in the upper elevations of the RMPPA on north-facing slopes and in cold air drainages are individuals of species often found at elevations higher than typically characterize the RMPPA. These include spruces, firs, and Douglas firs. Logged conifers and subalpine meadows are also mapped in this vegetation zone. Most stands of these species occur on U.S. Department of Agriculture (USDA) USFS lands.

Grassland (23 Percent)

Three grassland types occur in the RMPPA: mixed-grass prairie, shortgrass prairie, and a shortgrass prairie variant sometimes called “desert grassland.” These grasslands are characterized below.

Mixed-Grass Prairie

Because of the altitude and prevalence of sandy soils, the Laramie Basin is an isolated pocket of mixed-grass prairie. Summers in this area are cool, which reduces evapotranspiration. Frequent thunderstorms in July and August maintain this grassland, a situation also found in higher precipitation zones to the north and east. Mixed-grass prairie is characterized by needle-and-thread, western wheatgrass, blue grama, Sandberg bluegrass, threadleaf sedge, needleleaf sedge, prairie junegrass, Indian ricegrass, prickly-pear cactus, globemallow, fringed sagebrush, and various species of milkvetch and locoweed. This area is predominantly used for livestock and wildlife grazing.

Shortgrass Prairie

The shortgrass prairie occurs in the southeastern corner of the RMPPA and is characterized by buffalo grass and blue grama. Other associated species include hairy grama, western wheatgrass, side-oats grama, yucca, and prickly-pear cactus (Barker and Whitman 1994). This area lies in the 12- to 20-inch annual precipitation zone in the rain shadow of the Rocky Mountains. Soils are sandy loams, loams, and clay loams. Most of the area is used for livestock grazing, and very little is managed by BLM. To the west, this vegetation type is replaced by the ponderosa pine and lodgepole pine forests of the Laramie Range.

Desert Grassland

On sandier soils and dunes, where water is more available and the shifting dunes are restricted by shrub establishment, desert grasslands commonly occur as a variant of shortgrass prairie. Common grass species include thickspike wheatgrass, slender wheatgrass, bluebunch wheatgrass, Indian ricegrass, needle-and-thread, Sandberg bluegrass, threadleaf sedge, and sand dropseed. Other shrubs and forbs growing among the grasses are sand sagewort, phlox, Hooker sandwort, bud sagebrush, fringed sagebrush, Wyoming big sagebrush, rubber rabbitbrush, horsebrush, and prickly-pear cactus (Knight 1994).

Saltgrass meadows occur in shallow depressions or adjacent to playa lakes where groundwater is near the desert surface. These areas are characterized by inland saltgrass, alkaligrass, alkali sacaton, and, in wetter areas, alkali cordgrass (Knight 1994). Desert grasslands provide palatable forage and often provide islands of diversity within the desert shrublands.

Shrub Communities

Shrublands dominate the majority of lands administered by BLM in the RMPPA. These areas are very diverse; therefore, several shrub community types are discussed in this section.

Greasewood (4 Percent)

Greasewood-dominated shrublands occur on the fringes of playas, desert lakes, ponds, and desert streams. Greasewood is a halophyte that does well in very saline soils; however, it needs more soil moisture to survive than does saltbush.

Where greasewood is the dominant shrub, subdominant shrubs include shadscale, Gardner saltbush, alkali sagebrush, and basin big sagebrush. The understory is limited to salt-tolerant herbaceous vegetation such as inland saltgrass, western wheatgrass, alkali sacaton, bottlebrush squirreltail, Sandberg bluegrass, biscuit root, pepperweed, and sea blight.

Large expanses of this vegetation type occur in the Great Divide Basin. Greasewood shrublands often occur on the terraces above wetter areas, where silver sagebrush or basin big sagebrush dominate (Knight 1994). Greasewood communities are often found adjacent to saltbush-dominated communities, growing in deeper, sandier soils and alluvial fans. Although greasewood is not considered palatable forage, pronghorn and sheep will eat the spiny twigs and leaves in the spring and early summer, and cattle use this species in summer and fall as a source of salt.

Mountain Shrub (6 Percent)

Bitterbrush Shrub Steppe

Bitterbrush-dominated plant communities exist on sand, sandy, and sandy loam soils in the 10- to 14-inch annual precipitation zones. Bitterbrush varies in height depending on soil depth, precipitation, and browsing. It may appear as a low spreading shrub about 6 inches tall, or as a tall shrub reaching 6 feet in height.

Bitterbrush is often a co-dominant with mountain or basin big sagebrush, and in the sand hills south of Rawlins it is intermixed with silver sagebrush, basin big sagebrush, and rabbitbrush in deep sand soils. At higher elevations and precipitation levels, bitterbrush occurs in mixtures with sagebrush, snowberry, serviceberry, mountain mahogany, and, occasionally, chokecherry. Herbaceous plants associated with bitterbrush include grasses such as needle-and-thread, bluebunch wheatgrass, Indian ricegrass, sand dropseed, and thick spike wheatgrass, and include forbs such as lupine, penstemon, sego lily, wild onion, larkspur, and prickly-pear cactus.

Bitterbrush is probably the most important winter browse species for mule deer in the region. Elk and cattle use it as well in the fall and spring. It responds best to low-intensity (cooler-season) prescribed burns, brush beating, and chemical treatment directed at killing sagebrush. Resprouting response to fire is considered fair to moderate when fires occur in low-intensity fires. High-intensity fires (fires with extreme energy release components and residual heat) will kill bitterbrush.

Mesic Upland Shrub Steppe

Serviceberry or chokecherry, or a combination of both, dominates the mesic upland shrub steppe community, often in conjunction with snowberry, currant, and wood rose. Good examples of this plant community occur on the middle elevations of Battle Mountain near Savery. These shrubs may reach 10 to

15 feet in height. They occur in dense stands or scattered patches, often adjacent to aspen or willow. Understory grasses include basin wildrye, green needlegrass, Columbia needlegrass, and Kentucky bluegrass, and forbs include bluebell, columbine, aster, violet, elkweed, chickweed, and stinging nettle.

This community provides hiding and thermal cover for deer, elk, and other wildlife species. The dominant shrubs provide excellent forage for browsing animals when their softer leaves and shoots stay within reach. These shrubs will reestablish following fire, often in less dense patches, making them more accessible to wildlife and livestock.

Xeric Upland Shrub Steppe

True mountain mahogany dominates the xeric upland shrub steppe plant community on dry rocky slopes or in very shallow, undeveloped soils in the 10- to 14-inch precipitation zone. It occurs as both the dominant shrub or as an understory of Utah juniper, occurs at higher elevations, and mixes with bitterbrush, snowberry, serviceberry, green rabbitbrush, broom snakeweed, and mountain big sagebrush. Common herbaceous plants include bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, and mat-forming forbs such as phlox, buckwheat, false locoweed, Hooker sandwort, goldenweed, and milkvetch.

True mountain mahogany may reach 5 to 7 feet in height depending on the amount of browsing and soil depth. Typical mountain mahogany communities occur in Telephone Canyon along I-80 east of Laramie, on the west end of the Ferris Mountains, and on Chalk Mountain near the Shirley Mountains. Fire generally lessens the density of the shrub stands, allowing grasses and other herbaceous plants to increase while still providing wildlife browse. Mountain mahogany is an important wildlife fall and winter forage. A notable characteristic is the hedging growth pattern exhibited by mountain mahogany plants after they have been browsed by mule deer and elk.

Sagebrush (36 Percent)

The GAP data represent sagebrush as black sagebrush, mountain sagebrush, and Wyoming sagebrush plant cover types, which are mapped collectively as sagebrush on Map 3-10. These three categories cannot readily be partitioned into the species of sagebrush actually found in the RMPPA, which are discussed below.

Wyoming Big Sagebrush/Grassland

The Wyoming big sagebrush/grassland is the most common vegetative cover type in south-central Wyoming. It occurs in shallow-to-moderately deep soil at lower elevations, giving way to basin big sagebrush in deeper soils and to mountain big sagebrush above 6,500 feet in elevation and within the 9- to 16-inch annual precipitation zones (Knight 1994). Shrub height varies from as little as 6 inches on shallow sites to around 30 inches in deeper soils. Canopy cover is generally lower than observed in either basin or mountain big sagebrush—usually under 30 percent.

Wyoming big sagebrush often appears as the dominant plant in mosaic communities intermixed with Gardner saltbush and open grasslands. In shallow, rocky-to-gravelly soils, Wyoming big sagebrush may co-dominate with black sagebrush, green rabbitbrush, and sometimes winter fat. Grass and forb species vary depending on soil texture, aspect, and slope. Common grass and grass-like species include bluebunch and thickspike wheatgrass, Sandberg and mutton bluegrass, Indian ricegrass, needle-and-thread, threadleaf sedge, and bottlebrush squirrel tail. Common forbs include phlox, Hooker sandwort, onion, goldenweed, sego lily buckwheat, penstemon, Indian paintbrush, globemallow, and prickly-pear cactus.

Wyoming big sagebrush is the most frequently eaten sagebrush and is a staple for pronghorn antelope, mule deer, and greater sage-grouse. It is also one of the dominant species found on antelope and mule deer crucial winter ranges. Fire is an important component of all sagebrush-dominated plant communities.

Depending on the nature of the site, the fire return interval can be between 25 and 100 years (Knight 1994).

Basin Big Sagebrush Shrubland

Basin big sagebrush shrubland is found in moderately deep-to-deep soils of all soil textures, in zones of 10 to 16 inches of annual precipitation (Beetle 1960). It occurs as pockets within Wyoming big sagebrush and Gardner saltbush communities, as the dominant plant type along valley bottoms and canyons, and along ephemeral washes. This subspecies of big sagebrush may reach 12 feet in height, with canopy cover reaching 70 percent.

Basin big sagebrush mixes with serviceberry, green and rubber rabbitbrush, snowberry, bitterbrush, silver sagebrush, and mountain mahogany, depending on the soil depth, annual precipitation, and elevation. Grasses occurring in these communities include basin wildrye, green needlegrass, Idaho fescue, thickspike wheatgrass, Kentucky and mutton bluegrass, and bottlebrush squirrel tail. Common forbs include bluebells, groundsel, onion, violet, buttercup, false dandelion, buckwheat, penstemon, Indian paintbrush, lupin, locoweed, and prickly-pear cactus.

Basin big sagebrush is not palatable forage. It usually shows little or no use, even in extreme winters when use levels of other plants are severe. It is important, however, as hiding cover for mule deer and elk and as habitat for other wildlife species. In some areas it also provides critical winter habitat for greater sage-grouse when snow covers most other shrubs. Basin big sagebrush increases in density and cover as the dominant plant species, and to even a greater degree when associated with poor livestock management and/or interruptions in the fire cycle. To increase diversity in basin big sagebrush shrublands, prescribed fires and chemical and mechanical treatments are employed, resulting in increases of grasses and other understory plants. The natural fire recurrence interval in the sagebrush type is approximately 30 to 75 years.

Mountain Big Sagebrush/Grassland

Mountain big sagebrush is located in shallow or moderately deep soils at elevations above 6,500 feet, in 12- to 20-inch annual precipitation zones. It is the dominant plant community on the Brown's Hill-to-Miller Hill plateau south of Rawlins. This is one of the largest homogeneous communities of this sagebrush type in the United States. Mountain big sagebrush also occurs as smaller plant communities at the lower mountain elevations, intermixed with aspen and conifer woodlands. Shrub height will vary from 10 to 30 inches, with canopy cover reaching 50 to 60 percent.

Mountain big sagebrush is usually the dominant shrub in foothill and mountain sage communities, with bitterbrush, serviceberry, snowberry, and mountain mahogany providing subdominant brush diversity. Grasses include Idaho fescue; king spike fescue; green and Colombia needle grass; Kentucky, mutton, and big bluegrass; elk sedge; and Ross' sedge. Common forbs found in these areas include Indian paintbrush, phlox, balsamroot, locoweed, lupine, larkspur, penstemon, and Oregon grape.

Mountain big sagebrush is palatable to wildlife, although browsing is limited during the winter when these habitats become unavailable because of snow. Following fire, mountain big sagebrush reestablishes as the dominant species more quickly than do other sagebrush types, often resuming dense canopy cover after approximately 40 years. The natural fire recurrence interval in this sagebrush type is approximately 25 to 75 years.

Silver Sagebrush/Grasslands

Silver sagebrush/grasslands have two subtypes with very different habitats. The most common is found in deep sandy soils and consists of silver sage as the dominant species. It is associated with basin big sage, green rabbitbrush, serviceberry, chokecherry, and wood rose. Herbaceous species include needle-and-thread, Indian ricegrass, prairie sandreed, sand dropseed, scurfpea, and prickly-pear cactus.

The second type of silver sagebrush is located in riparian habitat along streams above the wet sedge and willow riparian zone. This second riparian terrace is also habitat for basin wildrye, Kentucky bluegrass, streambank wheatgrass, redtop, Baltic rush, clover, checkermallow, aster, and, occasionally, cottonwood and willow.

Silver sagebrush is desirable forage for both livestock and wildlife, and it provides important habitat for big game and nongame species. Silver sagebrush responds well to prescribed fire as a management tool when it is dry enough to burn. Any disturbance in the silver sagebrush community may result in less desirable species increasing in prevalence due to the transition of soil types or low-moisture regime.

Low Sages—Alkali, Birdsfoot, Black, and Wyoming Three-Tip Sagebrush/Grassland

Alkali sagebrush is found growing in clay soils and, as its name implies, can withstand soils of higher alkalinity than can other sagebrushes (Beetle and Johnson 1982; Knight 1994). It occurs in relatively pure communities because of the high clay content and high cation exchange capacity in the soils in areas below 7,500 feet in elevation. Understory grasses include bluebunch wheatgrass, western wheatgrass, mutton bluegrass, bottlebrush squirreltail, and Indian ricegrass. Forbs noted at this site include wild buckwheat, biscuit root, and wild onion. Browsing on this sage is light.

Birdsfoot sagebrush is found in alkaline soils, where pH ranges from 8.5 to 11, and below 7,500 feet. At lower pH levels, birdsfoot sage mixes with Gardner saltbush, and it appears with a mixture of grasses and forbs on windswept ridges and hills. At higher pH levels, birdsfoot sagebrush occurs as a monoculture.

Black sagebrush occurs on gravelly-to-rocky soils that have a "shallow effective" rooting depth (less than 15 inches) and various textures from sandy loams to clay loams. On the plains north of the Ferris and Seminoe Mountains, it is the principal shrub present, but it will often intermix with Wyoming big sagebrush. Above 7,400 feet, it gives way to Wyoming three-tip sagebrush. It also has been observed as an understory shrub in true mountain mahogany stands. On sandy sites, it is commonly found with needle-and-thread, threadleaf sedge, Junegrass, sandwort, and buckwheat, whereas on loamy soils it will occur with wheatgrasses, bluegrasses, Indian ricegrass, phlox, onion, paintbrush, and penstemon. Black sagebrush sites rarely burn, probably because of the low production and shrub cover these sites support. In some locations, black sagebrush is considered an important browse species for mule deer.

Wyoming three-tip sagebrush occurs above 7,000 feet in the foothills and at the higher elevations of the mountain ranges. It normally grows between 4 inches and 15 inches tall in moderately deep, well-drained soils (Beetle and Johnson 1982). It is often found intermixed with mountain big sagebrush and black sagebrush. Understory grasses and forbs include Idaho fescue, king spike fescue, Colombian needlegrass, elk sedge, Ross' sedge, Indian paintbrush, mountain pea, larkspur, balsamroot, phlox, and buckwheat. Wyoming three-tip sagebrush-dominated areas are often used as forage for wildlife. This species does burn, but because of a lack of fuel continuity, large, resource-damaging fires are rare.

Saltbush (5 Percent)

Salt desert shrubland is perhaps the most arid vegetation type in the intermountain West (Knight 1994). Gardner saltbush dominates the salt desert shrub community type and in some instances occurs as up to 90 percent of the vegetation cover. These areas are characterized by accumulations of salt in poorly developed soils. Soils of these areas usually have a pH of 7.8 to 9, which restricts the uptake of water by all but the most salt-tolerant plants (halophytes). Soil textures can be sandy loam, sandy clay loam, or loam and clay. Salts accumulate around these plants each year with leaf fall. Halophytes function essentially to redistribute salts from the soil depths to the surface, thereby concentrating salts around the perimeter of the plant. This enables the plant to eliminate competition for scarce water and nutrients from other, less salt-tolerant plants (Goodin and Mozafar 1972).

Gardner saltbush normally grows no higher than 12 inches. It may grow along the ground, forming a mat. Subdominant shrubs include birdsfoot sage, bud sage, spiny hopsage, greasewood, broom snakeweed,

shadscale, spiny horsebrush, and winterfat. Grasses associated with these sites are Indian ricegrass, bottlebrush squirreltail, Sandberg bluegrass, and western wheatgrass. Forbs found in these areas include wild onion, biscuit root, woody aster, globemallow, princess plume, and prickly-pear cactus.

Salt desert shrublands occur at elevations between 6,000 and 7,600 feet within the lowest precipitation areas in the RMPPA. These areas are typically flat or rolling hills. Excellent examples of this type exist in the Separation Flats area west of Rawlins. Gardner saltbush is a valuable forage species on winter and spring ranges. In the spring when green, it has higher protein concentrations than does late-season alfalfa, and it is a preferred livestock forage.

Sand (1 Percent)

The sand vegetation zone is mapped as a combination of active sand dune type and sand dune complex type. A band of sand dunes stretches across the northern portion of the RMPPA. In addition, dunes are found near the western boundary of the RMPPA and in the Sand Hills, which are southwest of Rawlins and near the Dad homestead.

Blowout grass is a common early colonizer species on sands. Species that survive in the frequently shifting sands include Indian ricegrass, needle-and-thread, alkali wildrye, and slimflower scurfpea. Alkali cordgrass commonly occurs in areas where water accumulates (Knight 1994). Dune areas typically have earlier successional plant species unless the continued growth of vegetation leads to increased soil organic matter, increased soil structure, and lower wind velocities across the dunes, thereby stabilizing them. Stabilized dunes may provide habitat for later successional species, such as thickspike wheatgrass, Sandberg bluegrass, sand dropseed, Hooker sandwort and bud sagebrush, fringed sagebrush, Wyoming big sagebrush, rubber rabbitbrush, horsebrush, spiny hopsage, and prickly-pear cactus (Knight 1994).

Some dunes may become vegetated for a while only to suffer a blowout from atypical wind speeds or directions. Once such a blowout starts to enlarge, the destabilized dune becomes active again. These dunes provide habitat for unique plant species, such as blowout penstemon, which is Wyoming's only endangered plant species. Some places in these dunes may have more water than other places. Ice that forms in interstices between the sand grains provides supplemental water when it melts in the spring. In addition, snowdrifts that become insulated by a blanket of overblown sand may serve as a source of water for more permanent dunal ponds, particularly if there is an impermeable layer beneath the sand. High water levels in Seminoe Reservoir that indirectly raise the ground water table may also support the dunal ponds. Such ponds are an important source of water for wildlife in the midst of the sandy dunes.

Wetland/Riparian Communities (1 Percent)

The GAP data use three plant cover types to depict wetland/riparian communities: graminoid/forb-dominated wetlands, graminoid/forb-dominated riparian areas, and shrub-dominated riparian areas. These types provide the best reflection of wetland/riparian communities in smaller drainages, where agriculture has not extensively modified the vegetation. As noted previously, forest-dominated riparian communities have been mapped as part of the agriculture/town zone because of their extensive modification. These communities are no longer available as a substantive habitat, particularly in the eastern portion of the RMPPA.

Wetland/riparian vegetation communities in arid and semi-arid environments often are key sites for the local ecosystem. Most terrestrial animal and insect life depends on riparian or wetland areas as sources of water, forage, and cover. Wetland/riparian areas in good health maintain water quality and aquifers, control erosion, diminish the impact of floods, and act as a stabilizing force in western landscapes subject to frequent drought and dynamic precipitation cycles.

Wetland/Riparian Areas

Wetland vegetation depends on the hydrologic network of the watershed, the duration of water availability, geologic conditions, soil types and depth, climate, and management history. Sedges, rushes, cattails, willows, and other wetland obligates dominate the environment. As water availability decreases, herbaceous vegetation shifts from sedges (wetland obligates) to grasses and wetland facultative plants (plants that usually occur in wetlands but are occasionally found in other habitats).

Wetlands are a valuable natural resource, and impacts to these areas should be avoided wherever possible. Wetlands in the RMPPA are represented by—

- Shoreline vegetation around open water bodies
- Riparian vegetation along streams
- Open meadows that accumulate moisture in the winter and spring
- Dunal ponds associated with the Great Basin Divide Basin.

Based on GAP data, there are 87,445 acres in the RMPPA that can be classified as wetlands. Many of these areas are seasonally dry and infrequently inundated with water. Vegetation in these areas varies according to the frequency, depth, and duration of inundation. From an ecosystem perspective, an area that is unique to the wetland areas in the RMPPA is the dunal ponds, which are seasonally supported by precipitation that is trapped in the Great Divide Basin sand deposits. The variety of shrubs, grasses, and forbs present depends on the degree and duration of wetness and exposure at each location.

In most cases salt accumulation is not excessive in the wetland areas. Where drainage is limited, alkaline conditions can occur, and these can affect the types of plants that can be sustained. Wetland/riparian vegetation moderates stream water temperatures; adds structure to the river network; provides habitat for fish, birds, and wildlife; and provides organic material for insect production. Vegetated wetlands and flood plains dissipate stream energy, store water for later release, provide areas of infiltration for ground water, support the hyporheic zone of the river, and provide rearing areas for fish and animal species.

Public lands within the RMPPA boundaries provide potential habitat for obligate and facultative wetland/riparian plants (Appendix 28). Wetland vegetation can form nearly monotypic stands of vegetation (e.g., sedges or cattails) or diversified assemblages of plants. The determining factors appear to be availability of water, soils, and management actions on the surrounding lands. Meadows typically have a wider variety of plants, probably because of their more gradual transition from dry to wet conditions. Wetlands that are isolated by location and distance from other vegetation types typically are more likely to have a monotypic plant assemblage.

Three primary drainages occur within the RMPPA: the Colorado River watershed in the western portion, the North Platte River watershed in the eastern portion, and the Great Divide Basin in the northwest. Each of these basins has unique soil, geologic, and hydrologic characteristics that affect the potential for wetland development.

Desert Riparian

Many different types of desert riparian occur in the RMPPA, depending on the timing and duration of soil wetting, soil type and depth, and topography of the area. These types usually occur on alluvial material of sand, sandy loam, loam or an unconsolidated mixture of soil and cobble material. Soils are usually well-drained and are higher in organic matter content than the surrounding uplands. Streams are often ephemeral or intermittent; therefore, vegetation depends on spring runoff or spring and summer rain.

The wettest areas in the desert commonly support Baltic rush, Nebraska sedge, water sedge, and tufted hairgrass, with mountain iris, sandbar willow, and narrowleaf cottonwood occasionally occurring along the fringes. Seasonally wet areas in the desert and steppe communities commonly contain Kentucky bluegrass, tufted hairgrass, foxtail barley, redtop, northern reedgrass, slender wheatgrass, basin wildrye,

field horsetail, wood rose, shrubby cinquefoil, silver sage, basin big sagebrush, greasewood, and a variety of willow species.

Desert ephemeral washes may lie on saltier soils and therefore support salt-tolerant species. Inland saltgrass and western wheatgrass dominate this herbaceous community, whereas greasewood and basin big sagebrush are the dominant shrubs.

Irrigated nonfederal lands along the major streams and rivers in the desert have limited the extent of native vegetation in some riparian areas. Where topography and soils restrict irrigation of nonfederal lands, native vegetation persists. These areas sustain riparian woodlands that support trees and shrubs such as plains cottonwood, narrowleaf cottonwood, Fremont cottonwood, Geyer willow, sandbar willow, and yellow willow. The trees and shrubs often give way to herbaceous communities where soils are shallow. Herbaceous plants and lower shrubs dominating these areas would be part of the understory in the riparian tree communities. Vegetation includes slender wheatgrass, thickspike wheatgrass, smooth brome, tufted hairgrass, meadow foxtail, timothy, mountain iris, horsetail, gooseberry, currant, buffalo berry, and basin big sagebrush. Such communities are located along the fringes of the riparian areas or in rocky areas.

Riparian areas are associated with the highest production of grasses and other very palatable herbaceous species in the desert as well as with the greatest plant diversity. Often open water is also present. These characteristics draw both livestock and wildlife and also provide critical habitat to many species that depend on water for survival. Desert riparian communities normally represent less than 1 percent of the total area in the desert. This places additional pressure on the management of riparian sites for ecological and hydrological sustainability. Management of BLM livestock allotments is often focused on limiting grazing on the desert riparian areas to preserve their valuable diversity and productivity.

Foothills and Mountain Riparian

Riparian areas in the foothills and mountains are generally moister for longer periods of time and support plants that need to be in wet or saturated soils throughout the growing season. The stream gradients are also steeper, and the streambed material much larger. Riparian areas in the foothills and mountains receive snowmelt and spring discharges that provide perennial flow and cooler water. The soils are usually coarser, with higher organic matter content and increased soil development compared with lower elevations. These areas range in elevation from 7,500 to 10,000 feet and may include alpine tundra characteristics in the upper reaches of the watersheds.

Willow is often the dominant species in these environments. Frequently observed are sandbar willow, Geyer willow, yellow willow, whiplash willow, Wolf willow, Booth willow, Bebb's willow, and plain leaf willow. Species prominent in the composition of the willow understory include beaked sedge, Nebraska sedge, water sedge, field sedge, Baltic rush, bull rush, spike rush, tufted hairgrass, Kentucky bluegrass, meadow foxtail, and reedgrass. These understory plants dominate in the open meadows and marshes. Other shrubs and trees that occur are water birch, shrubby cinquefoil, redosier dogwood, snowberry, skunkbrush sumac, narrow leaf cottonwood, aspen, Englemann spruce, and lodgepole pine (Knight 1994).

As in the desert riparian area, mountain riparian vegetation is more diverse and higher in productivity than the surrounding uplands, causing livestock and game to concentrate there. The forage also stays lush and more palatable into the late summer (when upland grasses have cured), adding to the attractiveness of these areas. Livestock management strategies often include controlled season and duration of use of these areas.

3.15.3 Riparian Proper Functioning Condition

Proper Functioning Condition (PFC) is the assessment tool the RFO staff uses to determine the relative health of stream hydrology, riparian vegetation, and the aquatic fauna and flora of creeks in the RMPPA. Wetlands are also evaluated. Emphasis is placed on these communities because of the importance of aquatic systems in the semi-arid climate of the RMPPA and because the deterioration of vegetative health can result in excessive erosion, alteration of narrow sinuous creek beds into fan-shaped drainages that no longer feed the water table, and the consequent conversion of perennial streams into ephemeral drainages. A wetland system is considered rated as PFC when adequate vegetation or land form is present to dissipate energy associated with high water flows or other environmental disturbance; is able to function as a wetland appropriate to the setting to filter sediment, develop root masses that stabilize banks, and improve water retention; and provides diverse ponding or channel characteristics and the biodiversity and habitat needed to support aquatic organisms and waterfowl.

PFC surveys are used to evaluate Standard No. 2, Wetland/Riparian Health, of the Rangeland Standards Assessment Process. PFC surveys determine whether the stream and riparian areas are meeting minimum requirements for proper ecological and physical processes. The PFC assessment takes into consideration—

- Frequency at which the streamflow exceeds bankfull and inundates the floodplain
- Past and present beaver activity
- Channel morphology in relation to landscape setting
- Changing riparian and watershed relationships that may impact stream integrity
- Upland watershed condition and its potential effect on riparian and stream channel condition
- Age structure of the riparian plant community
- Presence and absence of indicator riparian species
- Riparian stream soil moisture
- Ability of the stream bank vegetation root system to resist high flows and subsequent erosion
- Vigor and condition of indicator wetland/riparian species
- Adequacy of water energy dissipation and stream armoring by vegetative cover
- Maintenance of organic woody material in wetland/riparian areas
- Stream channel roughness and ability to resist erosion caused by increased flows
- Evaluation of in-channel vegetation as an indicator of seasonal flow regimes
- Channel stability in regard to lateral and vertical movement
- Sediment and water discharge relationships in relation to watershed dynamics.

PFC surveys can be combined with macroinvertebrate and vertebrate sampling, stream/riparian cross-section surveys, upland vegetation cover analysis, and assessment of the watershed and riparian area management. Photographs are also taken from specified points associated with the surveys. Additional surveys that address specific water quality and aquatic habitat parameters may be initiated if species or habitat needs indicate that more detailed information is required.

The RFO staff has been conducting PFC assessments for many years. Data from these surveys are used together with data collected in overall watershed assessments under BLM Standards and Guidelines. Assessments are being conducted on seven watershed management areas that represent the fourth-order watersheds in the RMPPA (Section 3.17). PFC data are used to supplement the Standards and Guidelines assessments.

3.15.4 Noxious and Invasive Weed Management

Noxious and invasive weeds are identified as a major threat to native ecosystems and multiple-use. They contribute to the loss of rangeland productivity, increased soil erosion, reduced native species diversity,

and loss of wildlife habitat and, in some instances, are hazardous to human and animal health and welfare (Federal Noxious Weed Act, Public Law 93-629). Waterways, roads, and animals are the principal vectors for expansion of noxious and invasive weed species. Weeds are a component evaluated during Standards for Healthy Rangelands assessments (Appendix 8).

Noxious and invasive weeds cannot be adequately controlled unless federal, state, county, and private interests work together. The Carlson-Foley Act (Public Law 90-583) as well as state and county laws hold the Federal Government responsible for control of designated weeds on federal land and provide direction for their control. The Noxious Weed Prevention Plan (Appendix 31) outlines Best Management Practices that can be used at the project level to reduce the occurrence and dispersion of weeds in the RMPPA.

The following list contains Wyoming designated noxious plants and their current known general locations (Wyoming Weed and Pest Control Act 1973). (This list is not all-inclusive.)

- **Leafy Spurge.** North Platte River corridor down to Seminoe Reservoir; Muddy Gap; and Baggs
- **Spotted Knapweed.** Saratoga Valley, Upper North Platte River, Seminoe, Arlington, Elk Mountain, Rawlins, Highway 789: Creston Junction to Dad
- **Diffuse Knapweed.** Seminoe, Saratoga, and Roger's Canyon by Laramie
- **Russian Knapweed.** Muddy Gap, Sage/Little Sage Creek south of Rawlins, Seminoe, Wamsutter, Hay Reservoir, North Platte River corridor, and Bell Springs
- **Musk Thistle.** Saratoga/Encampment, Atlantic Rim, and Baggs
- **Scotch Thistle.** Seminoe Road, Robbers Gulch
- **Plumeless Thistle.** Seminoe, Loco Creek, and Highway 789: Creston Junction to Baggs
- **Canada Thistle.** Along drainages throughout the RMPPA
- **Field Bindweed.** Scattered throughout the RMPPA
- **Dyers Woad.** Railroad corridor Tie Siding to Cheyenne
- **Hoary Cress.** Wamsutter, Sage/Little Sage Creek south of Rawlins, North Platte River corridor, and Hanna
- **Perennial Pepperweed.** Little Sage Creek, Sugar Creek, Rawlins, Dixon, Hay Reservoir, and Herrick Lane
- **Dalmatian Toadflax.** Rawlins, Laramie, Snowy Range-Centennial, Hanna, Seminoe, Vedavoo, I-80 and railroad corridors Cheyenne to Laramie/Tie Siding
- **Yellow Toadflax.** Upper North Platte River, Encampment, and Muddy Creek southwest of Rawlins
- **Skeletonleaf Bursage.** None known
- **Houndstongue.** Baggs, Arlington, Ryan Park, Battle Mountain-Horse Creek, Loco Creek, Lindsey Creek/Spring, Laramie Peak area, and Sybille Canyon
- **Common Burdock.** Arlington, Baggs-Battle Mountain, and Sybille Canyon
- **Quack Grass.** Not inventoried

- **Perennial Sowthistle.** Not inventoried
- **Oxeye Daisy.** Upper North Platte River
- **Purple Loosetrife.** None known
- **Saltcedar.** Hay Reservoir, Sand Creek and Willow Creek north and west of Baggs, Wamsutter, Robbers Gulch/Blue Gap/Muddy Creek area, Saratoga, and North Platte River corridor Fort Steele to Kortez Reservoir
- **Common Tansy.** Not inventoried
- **Common St. Johnswort.** None known.

The current treatment focus is on noxious weeds; however, controlling invasive species (halogeton, henbane, and cheatgrass) that cause management problems related to livestock, wildlife, and human activities is a secondary focus. Surface disturbing activities, such as road and pipeline construction, are increasing the presence of invasive species. Historic livestock management practices also led to the introduction and expansion of weeds. For example, some species require bare ground to germinate. Improved livestock management practices increase ground cover, which reduces the frequency of these species. Prompt reclamation of surface disturbances also reduces the opportunities for weed expansion. However, herbicide treatments are usually required for control. Perennial weed species, such as knapweeds, spurge, and saltcedar, usually spread regardless of land management practices and also require additional control methods to contain them and reduce spread. In larger, more established patches, eradication is often not possible, so control and containment methods are used to reduce spread. Halogeton is of concern because it is commonly found in finer textured disturbed soils and is poisonous to livestock, especially sheep. Cheatgrass is of concern because it outcompetes native grasses and increases the potential for wildland fire. Cheatgrass occurs in the Laramie Peaks region, Upper North Platte regions, Sweetwater Rocks, and other localized areas with shallow soils on south- and west-facing slopes and in areas of disturbance (e.g., roadsides, livestock and wildlife concentration areas, recreation sites).

The current untreated, known weed-infested acreage is estimated at 20,000 acres (not including areas infested with cheatgrass). However, most of the RMPPA has not been inventoried for noxious and invasive species; thus, the actual number of acres needing treatment has not been established. Also, unknown patches will continue to spread until found and controlled.

3.15.5 Poisonous Plants

Poisonous plants are a normal component of the ecosystem. Most poisonous plant species will kill animals only if they are eaten in large amounts, such as a virtual straight diet (Stoddart, Smith, and Box 1975). Several factors, such as time of year and climate conditions, influence poisoning occurrence and severity, in addition to the animals' seasonal susceptibility, the age and species of animal, and a mineral deficiency in the diet.

A shortage of salt in the diet may cause animals to eat plants they would not normally eat. Shortages of other minerals such as phosphorus induce abnormal appetites, causing animals to consume low-value vegetation, including poisonous plants. On a large scale, poisonous plants have a minimal effect on livestock operations. However, on a local scale, use of specific areas or pastures can be limited by poisonous plant presence.

The high occurrence of selenium in soils of south-central Wyoming results in specific plants (woody aster, for example) absorbing selenium, which can be toxic when consumed by livestock. Selenium acts as a cumulative poison, and can cause chronic poisoning effects over a long period or quick death if consumed in quantity. Local names for this poisoning effect include "alkali disease" and "blind staggers."

Large concentrations of woody aster and other selenium-accumulating plants occur in Poison Basin west of Baggs, Sage Creek Basin south of Rawlins, Alkali Basin north of Sinclair, and Hanna and Shirley Basins.

More than 20 species of poisonous plants are known to exist in the RMPPA. Table 3-33 lists some of the poisonous species, dangerous seasons, and grazing animals endangered. Poisonous noxious species are not included in the table.

Table 3-33. Poisonous Plants in the RMPPA

Species	Dangerous Season(s)	Kind of Livestock Endangered
Arrowgrass	All	All
Chokecherry	All	All, especially sheep
Death camas	All, especially spring	All, especially sheep
Greasewood	Spring, summer, fall	All, but mostly sheep
Halogeton	All	All, but mostly sheep
Horsebrush	Spring	Sheep
Horsetail	Haying season	All, especially cattle and horses
Low larkspur	Early spring	Cattle
Tall larkspur	Early summer	Cattle
Loco	All, especially spring	All
Lupine	Spring, summer, fall	Sheep
Prince's plume	Spring and summer	All
Russian knapweed		
Senecio	Spring and summer	All
Western waterhemlock	Spring	All
Woody aster	Spring and summer	All

Source: Stoddart, Smith, and Box 1975; *Poisonous Plants of Livestock in the Western States*, USDA, 1980.

3.15.6 Threatened, Endangered, Candidate, and Proposed Plant Species

Special Status Plant Species include candidate, proposed, threatened, and endangered species as well as Wyoming BLM State Sensitive Species. The list of Wyoming BLM State Sensitive Plant Species includes species that are of concern. Appendix 10 lists current threatened and endangered (T&E) plant species in the RMPPA and other current species on the BLM Wyoming State Director's Sensitive Species List.

Special Status Plant Species occur in a variety of plant associations and a variety of physical habitats, many of which have distinctive soil types. Several Special Status Plant Species often occur together in plant communities that may exhibit fidelity to specific locations and substrates and ultimately result in the development of unique subspecies. BLM Manual 6840, *Special Status Species Policy*, sets guidelines for Special Status Plant Species. These selected species receive priority attention for inventories, research, monitoring, and management decisions concerning surface disturbing activities. There is one endangered plant species (the blowout penstemon) and there are two threatened species (the Ute ladies'-tresses and the Colorado butterfly plant) that are located within the RMPPA. In addition, plant species that have been identified on the BLM Wyoming State Director's Sensitive Species List will be discussed in further detail in Section 3.15.7.

Blowout Penstemon Plant

The blowout penstemon plant is of particular interest in the RMPPA. This plant is a federally listed endangered plant that was previously thought to occur only in the Nebraska Sand Hills. It is the rarest plant species native to the Great Plains, is the only endangered plant in the state, and occurs in the band of moving sand dunes across the northern portion of the RMPPA (USDI, BLM 2004b).

Ute Ladies'-Tresses Plant

The Ute ladies'-tresses plant has the potential to occur in riparian habitat on public lands within the RMPPA. It is a perennial terrestrial orchid known to occur in western Nebraska, central and southeastern Wyoming, north-central Colorado, northeastern and southern Utah, east-central Idaho, southwestern Montana, and north-central Washington (USDI, BLM 2004b). In Wyoming, the plant is currently known from four counties and nine occurrences that represent three watersheds and geographic centers of distribution in eastern Wyoming, including a portion of the Antelope Creek watershed (Converse County), a portion of the Niobrara River watershed (Niobrara County), and a portion of the Horse Creek watershed (Goshen and Laramie Counties) (Heidel 2007).

Colorado Butterfly Plant

The Colorado butterfly plant has the potential to occur in riparian habitat on public lands within the RMPPA. The plant is a short-lived perennial herb. Prior to 1984, no extensive documentation of the plant's range had been achieved. The plant is a regional endemic of southwestern Nebraska, southeastern Wyoming, and northeastern Colorado. In Wyoming, this plant is known only from the southeastern plains in Laramie and Platte Counties, between the boundary of the Medicine Bow National Forest and the Wyoming-Nebraska border. Recent surveys in Wyoming suggest that the extant populations are probably stable, although population sizes may vary from year to year.

Two populations of this plant have been documented to occur at the F.E. Warren Air Force Base in Cheyenne. Other populations within the RMPPA are located on private lands between the Medicine Bow National Forest Boundary (Pole Mountain) and the Wyoming-Nebraska border on Middle Crow Creek, North Fork Crow Creek, South Branch Crow Creek, Lodgepole Creek, and Horse Creek. There are three small populations that are found partly or fully on state school trust lands, which are managed mostly for agricultural uses. Most of the plant population locations that are known to occur for the Colorado butterfly plant exist on private lands. No populations are known to occur on BLM-administered federal lands in the RMPPA (USDI, BLM 2004b).

3.15.7 BLM Wyoming State Director's Sensitive Species List for Plants

BLM is responsible for managing sensitive plants species on the Wyoming State Director's Sensitive Species List. Plant species listed on the BLM Wyoming State Director's Sensitive Species List and their associated habitat types are discussed in detail below. These plants are recognized as being of particular interest to the public and are a focus of management:

- **Laramie Columbine.** Crevices of granite boulders and cliffs at 6,400–8,000 feet in elevation
- **Nelson' Milkvech.** Alkaline clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders in sparsely vegetated sagebrush, juniper, and cushion plant communities at 5,200–7,600 feet in elevation
- **Cedar Rim Thistle.** Barren, chalky hills, gravelly slopes, and fine-textured, sandy-shaley draws at 6,700–7,200 feet in elevation

- **Weber’s Scarlet Gilia.** Openings in coniferous forests and scrub oak woodlands at 8,500–9,600 feet in elevation
- **Gibben’s Beardtongue.** Sparsely vegetated shale or sandy-clay slopes at 5,500–7,700 feet in elevation
- **Persistent Sepal Yellowcress.** Riverbanks and shorelines, usually on sandy soils near the high water line
- **Pale Blue-Eyed Grass.** Wet meadows, stream banks, roadside ditches, and irrigated meadows at 7,000–7,900 feet in elevation
- **Laramie False Sagebrush.** Cushion plant communities on rocky limestone ridges and gentle slopes at 7,500–8,600 feet in elevation.

3.15.8 Unique Plant Communities

In addition to Special Status Plant Species, the RMPPA contains rare or unique plant communities that may or may not contain Special Status plants, such as the Muddy Gap cushion plant community. Two other examples of these communities include the alkaline desert wetland communities found in the Chain Lakes area and the Sandhills “sand dune” plant community.

Chain Lakes Alkaline Wetlands

These wetlands are located about 25 miles northwest of Rawlins (Township 23 North, Ranges 92–93 West) and are managed cooperatively by the WGFD and BLM as the Chain Lakes WHMA. This area is one of the lowest (6,500 feet in elevation) topographic regions within the Great Divide Basin, resulting in numerous perennial and intermittent shallow lakes that are alkaline due to the lack of external water outlets. The annual precipitation of less than 7 inches, high evaporative loss rates, and surface salt crusting also contribute to shaping this community. The lakes and adjacent moist soils support a variety of plant species adapted to this environment. These species include Nuttall’s alkaligrass, tufted hairgrass, inland saltgrass, alkali cordgrass, mat muhly, Baltic rush, American bulrush, slim sedge, alkali plantain, sea milkwort, Rocky Mountain glasswort, hairy goldaster, buttercup, cinquefoil, and greasewood. This plant community and aquatic habitat are important for local wildlife such as greater sage-grouse, antelope, coyote, and small mammals as well as many migratory birds in both the spring and the fall. Commonly observed bird species are avocet, stilt, killdeer, phalarope, sandpiper, swallow, northern harrier, sandhill crane, duck, grebe, and various neotropical birds.

Sandhills (Dunes) Shrubland Community

The Sand Hills are located midway between Rawlins and Baggs in the west half of Township 17 North, Range 90 West. This site consists of deep, predominantly stable sand dunes, on a west-facing slope ranging from 7,000 to 8,000 feet in elevation that receives 10 to 14 inches of precipitation annually. Shrubs are the dominant plant lifeform, consisting of silver sagebrush, bitterbrush, big sagebrush, prickly-pear cactus, cotton horsebrush, and rabbitbrush, with pockets of serviceberry, snowberry, wild rose, and chokecherry occurring at the middle and higher elevations. Small stands of aspen also are present at higher elevations on north-facing slopes. Common herbaceous species include needle-and-thread, Indian ricegrass, prairie sandreed, thickspike wheatgrass, sand scurfpea, cryptantha, veiny dock, lupine, goosefoot, evening primrose, groundsel, and tansy mustard. This area provides crucial winter range for mule deer and elk, as well as seasonal habitat to many small birds and mammals and to greater sage-grouse and Columbian sharp-tailed grouse.

Cushion Plant Communities

Cushion plants communities are usually referred to by the growth form of vegetation found along windswept ridges on shallow soils. These plants have stems and leaves that are densely compacted near the ground. It is believed that these plants' growth form has adapted to conserve energy under severe environmental conditions such as high winds and extreme cold.

Muddy Gap Cushion Plant Community

This plant community is located 45 miles north of Rawlins (NE corner of Township 27 North, Range 89 West) on the west end of the Ferris Mountains and immediately southeast of Muddy Gap. The uplift limestone formations or "hogback ridges" combined with strong winds, dry climate, and shallow rooting depths form the contributing characteristics of this community. Most of the plant species found here have a cushion plant growth form and nearly all are endemics (known to occur only in Wyoming). Endemic species include bun milkvetch, Wyoming locoweed, and Devil's Gate twinpod, while near-endemic species include summer orophaca and Wyoming miner's candle. Other plant species observed in this area include bluebunch wheatgrass, little bluegrass, black sage, fringed sage, Hood's phlox, Hooker sandwort, stemless hymenoxys, and fleabane.

Laramie False Sagebrush (*Sphaeromeria Simplex*) Cushion Plant Communities

Laramie false sagebrush is on the BLM sensitive species list and occupies rocky limestone ridges and gentle slopes between 7,500 and 8,600 feet in elevation. This plant is endemic to southeastern Wyoming and known to occur from numerous cushion plant sites in the Shirley basin region north and northeast of Medicine Bow in Carbon and Albany Counties. The specific locations are on record with the Wyoming Natural Diversity Database (WYNDD) at the University of Wyoming. Other associated plant species include American Rock Cress, Devil's Gate Twinpod, Feverfew, Wyoming locoweed, bluebunch wheatgrass, and Wyoming three-tip sagebrush.

3.16 VISUAL RESOURCES

Visual resources within the RMPPA are influenced by a wide variety of topographic, geologic, hydrological, vegetative, and other characteristics of the region. Landforms range from relatively flat land; to low mountains, low rolling or flat-topped hills, and isolated hills; to higher elevations near the Medicine Bow National Forest containing mountain shrub vegetation and alpine forest atop the highest areas. Elevation and precipitation vary widely within the RMPPA and determine the dominant vegetation. With the widely diverse vegetation patterns that result from varying topographic soils and precipitation characteristics come changes in color, form, line, and contrast. These four elements form the basis for the analysis of the visual resources of the area.

Visual resources are often associated with recreational opportunities, as discussed in Section 3.11. Many recreational activities, such as backpacking, geologic and nature study, photography, and hiking, depend on the natural settings and scenic views that visual resource management (VRM) is intended to protect.

3.16.1 Natural Settings and Scenic Views

Much of the RMPPA contains natural settings with limited development, open spaces with panoramic vistas, and scenic views. In the non-mountainous, lower elevations of the area, summer views are characterized by scrubby low-growing gray-green vegetation, distant mountains, and an intense blue sky. In contrast, winter views are monochromatic gray, with clear skies and an apparently lifeless gray-to-brown foreground backed by distant snow-capped mountain peaks. Different combinations of plant communities create subtle changes in mosaics of textures and colors. More extensive views that encompass several viewsheds are available from high points. The horizon is a significant aspect of all distant views.

Several areas within the RMPPA that exhibit high scenic quality are easily accessible for tourists and other recreationists. The highest quality scenic views in the RMPPA are the WSAs, particularly the Ferris Mountains and Adobe Town WSAs because of their unique geological formations. Both of these areas are quite rugged and untrammelled by humans (Clair 2002b).

Visibility

Visibility can be defined as the distance one can see and the accompanying ability to perceive color, contrast, and detail. The RMPPA is essentially rural in character, and the Wyoming Air Quality Division has designated the area in attainment of all U.S. Environmental Protection Agency (EPA) national pollution and ambient air quality standards. As discussed in Section 3.2, the Savage Run Wilderness and Rocky Mountain National Park have been designated as prevention of significant deterioration (PSD) Class I areas. PSD Class I areas receive the highest degree of protection from air pollution; only small amounts of particulate, SO₂, and NO₂ air pollutants are allowed in these areas.

Visibility trend analysis for Rocky Mountain National Park (to the south and southeast of the RMPPA) reveals no significant worsening of visibility from 1989 through 1998. The information from this nearby monitored area and from local observations indicates that the air quality of the RMPPA is generally excellent, and that pollutants very seldom obscure visibility.

Visual Resource Management System

Guidance to manage visual resources is found in BLM Land Use Planning Handbook H-1601-1, Appendix C. Land use planning decisions mandate BLM to manage visual resource values in accordance with VRM objectives (management classes) and to designate VRM management classes for all areas of BLM land, based on an inventory of visual resources and management considerations for other land uses. VRM management classes may differ from VRM inventory classes based on management priorities for

land uses. (BLM Land Use Planning Handbook H-1601-1, Appendix C, Page 11). The RMPPA has been inventoried using the BLM VRM classification system. Under this system, the RMPPA was classified into four visual management categories (Classes I through IV) based on scenic quality, visual sensitivity levels, and viewer distance zones. Each VRM classification has a management objective, as described below:

- **Class I.** The objective of Class I 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 Class II 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 Class III 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 Class IV 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. Every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic visual elements of form, line, color, and texture.

The established VRM classes for the RMPPA are depicted in Map 2-51. The acreage for each VRM class within the RMPPA is shown in Table 3-34. About 75 percent of the lands within the RMPPA are categorized as Visual Class III. Class II lands are primarily associated with areas around the Pathfinder and Seminoe Reservoirs and with the close-range viewsheds of the Medicine Bow National Forest. Only the WSAs are rated as VRM Class I.

Table 3-34. Visual Resource Management Classifications and Acreages in the RMPPA¹

Classification	Acres	Percentage
I	68,160	2
II	359,610	10
III	2,676,950	75
IV	446,760	13
Total	3,551,480	100

¹ All lands in the RMPPA were rated; however, only the BLM-administered lands are managed within the VRM system, and only BLM lands are included in the above-referenced acreages.

The current objective of VRM within the RMPPA is to minimize adverse effects on visual resources while maintaining the effectiveness of other land use allocations. Visual resources in the RMPPA are managed according to the VRM classes to which they are assigned.

Visual Resource Trends and Issues

There are several visual resource trends in the RMPPA (Clair 2002b), as follows:

- The existing Rawlins RMP describes those areas that have been designated for OHV use. OHV use is not yet highly popular in the RMPPA; however, an increase in unmanaged, unmonitored OHV use within the area for both recreation and access to the surrounding USFS-managed lands in the Medicine Bow National Forest and to the dunes area is creating direct, negative visual impacts in certain parts of the area. OHV use has affected some vegetative communities more than others.
- The widespread development of petroleum, natural gas, and coal in the RMPPA is creating direct, negative visual impacts within the RMPPA. Currently, visual mitigation of this activity is preventing mineral development activities from exceeding the established VRM objectives within these areas. The trend toward continued expansion of natural resource development is creating areas of potential conflict between this activity and the established VRM class objectives.
- Utilities are also having an increasing visual impact in the RMPPA. Even buried fiber-optic lines leave obvious visual effects.
- Although visual sensitivity is clearly not the highest priority for many residents and visitors, as increasing numbers of sightseers and persons seeking various types of recreational opportunities pass through the RMPPA an awareness of scenic values and the existing scenic quality grows for some residents and visitors.

Emerging visual resource issues (Clair 2002b) include the following:

- Degradation of visual resources within the coalbed natural gas project on Seminoe Road. The road is a backcountry byway, and portions of the project area are in the VRM Class II area. Efforts are needed to hide the roads, use the topsoil as berms to hide the well pads, and paint the fixtures to match natural conditions. However, there is no control over what effects occur within the private portion of the land ownership checkerboard.
- The need for more effective mitigation on seismic projects.
- The need for more effective mitigation within the transportation corridors (such as I-80), even if they are Class IV lands. Because the transportation corridors are also the utility corridors, the existing impacts are difficult to change.
- The need for more effective mitigation on wells to reduce visual and environmental impacts associated with oil and gas development to prevent exceedance of VRM Management Class Criteria. See Appendix 15 and Appendix 25.

3.17 WATER QUALITY, WATERSHED, AND SOILS

3.17.1 Water Quality and Watershed

Climate, geology, and topography shape the water quality and quantity for both surface and ground waters in the RMPPA. The climate of the RMPPA has been broadly classified by Martner (1986) as steppe, desert, alpine, and alpine tundra. In most climate classification systems, Martner's definition of alpine and alpine tundra would correspond to subalpine and alpine, respectively. The geology of the RMPPA is dominated by geologic structural basins (Hanna, Great Divide, Green, Washakie, Kindt, Laramie, and Shirley Basins) and five major uplifts (Rawlins Uplift, Sweetwater Arch [including the Ferris and Seminoe Mountains], Shirley-Freezeout Mountains, Medicine Bow Mountains, and Sierra Madre). The watersheds in the RMPPA drain into the Colorado River, Platte River, and Great Divide basins. Streamflows are dominated by spring snow melt runoff and rain storms in May and June for intermittent to perennial systems and summer rainstorms for ephemeral systems. Precipitation ranges from almost 44 inches in the Sierra Madre mountain range to less than 6 inches per year in portions of the Great Divide Basin (Bartos et. al. 2006).

The climate of the RMPPA outside of the mountains is semi-arid to arid, with most locations having rainfall of 6 to 15 inches except for the shortgrass prairie near Cheyenne, which has 16 to 20 inches of rain (Curtis and Grimes 2004). Surface water resources include lakes, rivers, reservoirs, streams, creeks, water wells, and springs and are important for a variety of reasons, including economic, ecological, recreational, and human health. These water resources are important for the wildlife habitat they provide and as water sources for livestock, wildlife, and people in this arid and semi-arid environment.

The geological history of the RMPPA includes vast inland seas that formed into the Rocky Mountain intermountain basins. Sediments deposited in these inland seas formed structural basins made up of the coals, sandstones, shales, and other geologic material found in the RMPPA. The uplifts and mountain ranges have deformed these basins, creating dips and faults while exposing layers to erosion. These formations contain fresh and saltwater aquifers within these sediments as well as energy-rich mineral resources such as coal, uranium, oil, and natural gas. The geology of basins and ranges forms a topography important for surface water resources in the RMPPA (USGS 2004).

The RMPPA is topographically dominated by the Medicine Bow Mountains and the Sierra Madre in the south-central part of the RMPPA; the highest point is Medicine Bow Peak at 12,013 feet. The areas outside the mountain ranges include several commonly occurring landforms and vegetation types such as sage brush steppe, shortgrass prairie, active and vegetated sand dunes, playas, ridges formed by sedimentary rock outcrops, entrenched intermittent and ephemeral stream systems, river valleys with willow- and cottonwood-dominated floodplains, and land surface dissected by erosion, ranging from branching stream erosion patterns to intensely eroded badlands (Bartos et. al. 2006). The North Platte River is the largest stream system in the RMPPA and is regulated by three dams (Seminoe, Kortes, and Pathfinder), forming Pathfinder and Seminoe Reservoirs and forming the Miracle Mile, a Blue Ribbon trout fishery categorized as a Class 1 water between Kortes Dam and Pathfinder Reservoir. The Colorado River Basin includes the Muddy Creek and Savory Creek drainages that flow into the Little Snake River near Baggs and the Colorado border.

The Continental Divide splits around the Great Divide Basin, forming the western portion of the RMPPA. The Great Divide Basin has no known external drainage and contains ephemeral stream systems with the exception of portions of Filmore and Separation Creeks that are perennial near the headwaters. There are a number of large playas and regions with many small playas in the Great Divide Basin and in other basins in the RMPPA. Playas are low, flat, undrained areas, typically with clay bottoms, that pool water on the surface and accumulate salts.

The diverse climate, geology, and topography in the RMPPA form the surface and ground water resources. Portions of the headwaters of the Platte and Colorado Rivers are found in the RMPPA; these rivers supply water to millions of people in the western and midwestern United States. Water in the intermountain west is less abundant than in most of the United States and is an important source of water for other regions; therefore, proper and cautious management of water resources is essential.

Surface Water Characteristics

There are 22 fourth-order watershed sub-basins in the RMPPA, along with the major rivers, lakes, and reservoirs. Acreage for each of these watersheds is indicated in Table 3-35. Map 3-11 shows major surface water basins in the RMPPA. The RMPPA is topographically divided by the Continental Divide, which means that streams in the southwestern portion of the RMPPA are drained by Muddy Creek and the Little Snake River, which flows into the Colorado River system and eventually into the Gulf of California. Within the RMPPA, the North Platte, Medicine Bow, and Laramie Rivers drain watersheds east of the Continental Divide. These rivers flow into the Mississippi River system via the Platte River and eventually into the Gulf of Mexico. Streams to the north and west of Rawlins lie in the Great Divide Basin, which is a large, internally drained basin with no outflow. The rivers that convey the most water within the RMPPA are the Encampment River, Medicine Bow River, Laramie River, North Platte River, and Little Snake River, which consequently have long-term stream gauges operated by the USGS. Table 3-36 shows the monthly mean discharge data for these rivers at USGS gaging stations. Figures 3-53 through 3-58 present hydrographs of the daily statistics for these rivers. All the rivers have peak flows in May or June in response to snowmelt and display peaks in the maximum values in the late summer in response to thunderstorms. The flatter peaks in the mean values for the Laramie, Little Snake, and Medicine Bow Rivers indicate modifications to the system due to diversions for irrigation. Irrigation can also shift the peak to later in the year, as can be observed by comparing the maximum and mean and the 2003 values for the Medicine Bow River. In addition to using USGS data, BLM and/or local conservation districts collect additional flow data from other locations, such as Muddy and Sage Creeks, where water quality data are collected.

Table 3-35. Watersheds and Acreage Values Within the RMPPA

Water Resources Region	Sub-Region	Accounting Unit	Cataloging Unit	ACRES
Missouri	North Platte	North Platte	Glendo Reservoir	1,354,118
Missouri	North Platte	North Platte	Horse	1,070,448
Missouri	North Platte	North Platte	Little Medicine Bow	654,576
Missouri	North Platte	North Platte	Lower Laramie	1,528,285
Missouri	North Platte	North Platte	Medicine Bow	920,518
Missouri	North Platte	North Platte	Middle North Platte-Casper	2,210,280
Missouri	North Platte	North Platte	Pathfinder-Seminole Reservoirs	637,713
Missouri	North Platte	North Platte	Pumpkin	641,775
Missouri	North Platte	North Platte	Sweetwater	1,845,320
Missouri	North Platte	North Platte	Upper Laramie	1,384,875
Missouri	North Platte	North Platte	Upper North Platte	1,849,524
Missouri	South Platte	South Platte	Cache La Poudre	1,207,681
Missouri	South Platte	South Platte	Crow	890,192
Missouri	South Platte	South Platte	Lone Tree-Owl	361,861
Missouri	South Platte	South Platte	Lower Lodgepole	853,707
Missouri	South Platte	South Platte	Sidney Draw	474,460
Missouri	South Platte	South Platte	Upper Lodgepole	726,583
Upper Colorado	Great Divide—Upper Green	Great Divide Closed Basin	Great Divide Closed Basin	2,473,410
Upper Colorado	Great Divide—Upper Green	Upper Green	Bitter	1,413,961
Upper Colorado	Great Divide—Upper Green	Upper Green	Vermilion	609,582
Upper Colorado	White-Yampa	White-Yampa	Little Snake	1,940,746
Upper Colorado	White-Yampa	White-Yampa	Muddy	649,962

Table 3-36. Discharge from Selected USGS Streamflow Stations in the RMPPA**(Mean monthly, annual, and peak discharge from selected USGS streamflow stations throughout the RMPPA)**

USGS Site Number	Stream Name and Location	Drainage Area (mi ²)	Stream Discharge (cfs)														
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Mean Peak	Historical Peak
6625000	Encampment River at Mouth near Encampment, Wyoming	265	63	63	73	158	770	1,147	270	65	56	80	80	70	245	2,269	4,510
6630000	North Platte River above Seminoe Reservoir, near Sinclair, Wyoming	4,061	317	347	551	1,393	3,078	4,276	1,389	493	312	408	423	349	1,084	7,623	16,200
6635000	Medicine Bow River above Seminoe Reservoir, near Hanna, Wyoming	1,942	32	48	139	317	547	648	174	52	29	42	50	38	183	1,888	6,010
6670500	Laramie River near Fort Laramie, Wyoming	3,933	81	85	99	143	358	287	123	63	60	66	77	82	126	1,600	6,260
9253000	Little Snake River near Slater, Colorado	285	32	33	52	264	1,082	927	158	39	30	39	36	33	231	2,295	4,780

Reference: <http://waterdata.usgs.gov/nwis/sw>, updated 01/2007.

Water bodies in Wyoming are classified for water quality regulation according to beneficial uses by the Wyoming DEQ (Table 3-37). These classifications define numerical or empirical standards. All point source discharges are permitted with these classifications in mind using the WYPDES system. According to onshore order no. 7, BLM approves methods of disposal of produced water from oil and gas activities (Section 1.4.4). Wyoming standards for healthy rangelands (Appendix 8) provide consideration of non-point source pollution inputs for all BLM-permitted activities in order to meet Wyoming water quality classifications. BMPs such as those described in Appendix 13 and others as appropriate are applied during project planning or permitting, and they become conditions of approval when appropriate.

Table 3-37. Classification of Wyoming Surface Waters

	Drinking Water	Game Fish	Nongame Fish	Fish Consumption	Other Aquatic Life	Recreation	Wildlife	Agriculture	Industry	Scenic Value
1*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2AB	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2A	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
2B	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2C	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3A	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
3B	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
3C	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
4A	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
4B	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
4C	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes

* Class 1 waters are not protected for all uses in all circumstances; actual uses on each particular Class 1 water must be determined independently.

Source: WDEQ 2005a.

In general, the upper North Platte and Medicine Bow Rivers above Seminoe Reservoir are Class 2ab or Class 1 waters, depending on the location. Individual tributaries can be Class 2ab to Class 2c or 3b depending on background conditions. Very small portions of the Laramie or South Platte River watersheds are managed by BLM, and water quality classifications can vary greatly. The Lower North Platte (Seminoe and below) includes Class 1 waters at the Miracle Mile (a Blue Ribbon tailwater trout fishery) and the rest predominantly Class 2ab. A large portion of the Great Divide Basin is managed by BLM, and water quality is typically Class 3b, with some portions 4c, such as Red Creek.

The main watersheds in the Colorado River Basin included in the RMPPA are the Savery and Muddy Creek watersheds. Both of these systems drain into the Little Snake River very near the Wyoming-Colorado border. Savery Creek is predominantly 2ab with Class 3 waters in the headwaters. Muddy Creek is primarily Class 2c (Table 3-38).

Table 3-38. Classification of Selected Streams in the RMPPA

Surface Water*	Classification
Colorado River Basin	
Little Snake River	2AB
Savery Creek	2AB
Little Savery Creek	2AB
North and East Fork Savery Creek	2AB
Muddy Creek (Mouth to Sec. 29, T.17N, R.89W)	2C
Muddy Creek (Remainder)	2AB
Wild Cow Creek	2C
Cow Creek	2C
Dry Cow Creek	3B
Deep Gulch Creek	3B
Barrel Springs Draw	3B
McKinney Creek	2AB
Great Divide Basin	
Separation Creek	4C
Fillmore Creek	3B
Red Creek	3B
North Platte River Basin	
Little Laramie River	2B
Encampment River (USFS boundary to Colorado state line)	1
North Platte River (Pathfinder Reservoir to Kortess Dam)	1
North Platte River (Kortess Dam to Sage Creek)	2AB
Sage Creek	2AB
Little Sage Creek	2C
Sugar Creek	3B
North Platte River (Sage Creek to Colorado state line)	1
Encampment River (USFS boundary to Colorado state line)	1
South Platte River Basin	
Crow Creek (Above Avenue C in Cheyenne)	2AB

* Wetlands adjacent to listed waterbodies have the same classification.

Source: WDEQ 2005b.

Water quality classifications and background water quality are assessed during project planning and permitting. Surface water quality is protected to the maximum extent possible within the BLM's authority based on requirements with the State of Wyoming and EPA's administration of the Clean Water Act, BLM guidance, memoranda and directives, best science/monitoring, and environmental planning documents such as this one. Water quality is measured by the State DEQ, USGS, Water Conservation Districts, and other agencies depending on funding and interest (Section 3.17.2). The most long-term water quality sampling locations are on the larger main drainages such as the North Platte above Seminoe and are managed by USGS. Starting in the 1940s and 1950s, Water Conservation Districts began gaging

and sampling water quality. For a brief description of water quality conditions in the RMPPA, see Appendix 11.

Various streams in the RMPPA are identified in WDEQ's 2004 Wyoming 305(b) Water Quality Assessment Report to the EPA (WDEQ 2004b) as having water quality impairments or threats. Table S11-1 in this report summarizes the streams and potential problem parameters as listed on Wyoming's 303(d) list of waterbodies with water quality threats.

Most watersheds in the RMPPA are shrub-dominated rangelands below 8,500 feet. Watersheds in the desert and range areas of the RMPPA are in a water balance deficit, meaning the annual potential evapotranspiration exceeds the annual precipitation. Therefore, there is limited runoff from watersheds in these desert areas, and most streams originating in these areas are ephemeral.

Areas above 8,500 to 9,000 feet are in a water balance surplus, meaning that annual precipitation exceeds annual potential evapotranspiration. Most of the streamflows in these areas are perennial, and most of the large rivers originate in these high elevation areas, which are mostly located in national forests.

Watersheds originating in the mountains receive flow from melting snow and summer rainstorms. Discharge in these streams typically peaks in May or June. There is an additional peak in the daily records of most systems in August or September before discharge tapers off to a base flow. Streams originating in the desert areas respond to snowmelt as well; however, the peak flow from these streams occurs in April and May, and desert streams may go dry by early June. Following spring runoff, these streams flow only as a response to rainfall events. Perennial and intermittent streams that flow into sandy substrates may disappear or become intermittent along certain reaches.

The many dams and diversions along streams and rivers dampen the peak flows and enable higher flows through the late summer when irrigation water is needed. Dams and diversions have altered the normal seasonal flow patterns of many streams and rivers in the RMPPA and resulted in changes to the natural hydrograph. Dams have also altered the movement of sediment down rivers and most discharge cold, clean water during the hot months. This has enabled a prime trout fishery in the Miracle Mile below Seminoe Reservoir.

The Great Divide Basin lies in the northwestern portion of the RMPPA. This is a large, closed basin that splits the Continental Divide. None of the precipitation falling within the basin leaves through surface flow. This is a unique geological and hydrologic feature, because the Continental Divide does not split anywhere else in the United States.

Surface Water Quality

Water quality within the RMPPA is influenced by the type of rock and soils with which the water has been in contact, vegetation, groundwater interaction, and pollutants discharged into water bodies from point and non-point sources.

Table 3-39 shows water quality at USGS sites located around the RMPPA, and historical streamflow data are shown in Table 3-37 and in Figures 3-53 through 3-58. Human-induced impacts, such as changes in thermal and turbidity conditions in water bodies and impacts from increased salinity, heavy metals, and nutrients from irrigation or other discharges, affect natural water quality in this region. Water quality impacts within the RMPPA may be associated with agricultural runoff, road maintenance, removal of riparian vegetation, channel modification, stream bank destabilization, atmospheric deposition, resource extraction, oil and gas activities, urban runoff, and grazing activities. Heavy metal, nutrient, sediment, and salinity impacts can be associated with mining, oil and gas extraction, agricultural runoff, and other surface disturbing activities. Water quality typically varies as a function of flow conditions.

As water quality decreases, the ability of aquatic benthos, food base, and fisheries to maintain themselves is diminished. Stressors associated with increasing temperatures, lower dissolved-oxygen levels, changing

pH, and smothering from sediments negatively impact the aquatic ecosystem and diminish the ability of a stream system to sustain natural conditions.

The primary surface water quality concerns in the RMPPA are salinity in the Little Snake River basin and turbidity in the North Platte River Basin (Appendix 11). The Little Snake River is part of the Upper Colorado River Basin and is therefore covered by the Colorado River Basin Salinity Control Act. Many of the watersheds discharging water within the RMPPA are on highly erodible soils, notably Muddy Creek flowing into the Little Snake River and Sage Creek flowing into the North Platte River (Appendix 11). Elevated dissolved salt loading has been documented in Muddy Creek, and elevated suspended sedimentation loading has been documented in both Muddy and Sage Creeks. Reaches on both these streams have been or are listed as threatened on the State 303(d) list for sediment and/or habitat degradation (Table 11-1 of the 303[d] list).

All water discharged must be approved by the State of Wyoming under its National Pollutant Discharge Elimination System (WYPDES) Program (<http://deq.state.wy.us/wqd/>). The WYPDES Program requires that water quality not be degraded below numerical requirements for beneficial uses specified for the water bodies receiving the discharges or located below the discharges. Seminoe Reservoir and the North Platte River are water quality classification 2ab, which is the highest numerical standard and is protected for gamefish and drinking water. Portions of the North Platte River (the Miracle Mile and the headwaters) are considered Class 1 waters, meaning that water quality cannot be degraded by point source discharges.

Stream bank degradation and erosion due to poor vegetation cover within watersheds are the predominant sources of sediment and salinity found in RMPPA streams. Management of livestock grazing, road design, recreation planning, and regulation of oil and gas activities within the RMPPA often mitigate the impacts of these activities to the maximum extent possible. All small construction activities (1–5 acres) and large construction activities (greater than 5 acres) should follow the Wyoming WYPDES Storm Water Program requirements (see <http://deq.state.wy.us/wqd/> for more information). However, application of mitigation measures and BMPs will not remove all potential impacts from approved activities.

Water quality analysis from sampling taken at the USGS Streamflow Gaging Station shown in Table 3-36 is shown in Table 3-39. Average, high, and low values as well as periods of record are listed for selected parameters.

Table 3-39. Summary Data from USGS Surface Water Quality Stations Within the RMPPA

Stream Name and Location	Encampment River at Mouth near Encampment, Wyoming	North Platte River above Seminoe Reservoir near Sinclair, Wyoming	Medicine Bow River above Seminoe Reservoir near Hanna, Wyoming	Laramie River near Fort Laramie, Wyoming	Little Snake River near Slater, Colorado
USGS Site Number	6625000	6630000	6635000	6670500	9253000
Sample period	1965–1989	1960–2005	1965–1993	1965–2005	1957–2004
Drainage area (mi ²)	265	4,061	1,942	3,933	285
Number of samples ¹	233	480	222	297	211
Temperature (°C)	6.5 ₍₁₉₆₎	8.9 ₍₂₆₂₎	9.2 ₍₂₀₃₎	11.1 ₍₂₄₃₎	8.0 ₍₃₂₅₎
pH	7.8 ₍₁₆₇₎	7.9 ₍₄₇₁₎	8.0 ₍₁₂₈₎	8.1 ₍₂₁₄₎	8.0 ₍₂₂₎
Conductance, µmhos/cm (mean)	270 ₍₁₆₉₎	408 ₍₄₈₀₎	1,244 ₍₁₄₂₎	757 ₍₂₄₉₎	146 ₍₂₀₅₎
Conductance, µmhos/cm (min.)	43 ₍₁₆₉₎	142 ₍₄₈₀₎	422 ₍₁₄₂₎	365 ₍₂₄₉₎	17 ₍₁₄₂₎
Conductance, µmhos/cm (max.)	560 ₍₁₆₉₎	719 ₍₄₈₀₎	2,260 ₍₁₄₂₎	960 ₍₂₄₉₎	300 ₍₁₄₂₎
TDS ³ (mean)	171 ₍₉₀₎	269 ₍₃₁₁₎	909 ₍₉₁₎	502 ₍₁₅₁₎	389 ⁴ ₍₁₄₁₎
TDS ³ (min.)	40 ₍₉₀₎	106 ₍₃₁₁₎	316 ₍₉₁₎	242 ₍₁₅₁₎	3 ⁴ ₍₁₄₁₎
TDS ³ (max.)	344 ₍₉₀₎	481 ₍₃₁₁₎	1,620 ₍₉₁₎	640 ₍₁₅₁₎	3,770 ⁴ ₍₁₄₁₎
Suspended solids ² (mean)	nm	67 ₍₅₈₎	389 ₍₁₄₁₎	91 ₍₁₃₅₎	34 ₍₆₎
Suspended solids ² (min.)	nm	3 ₍₅₈₎	3 ₍₁₄₁₎	6 ₍₁₃₅₎	2 ₍₆₎
Suspended solids ² (max.)	nm	1,220 ₍₅₈₎	3,770 ₍₁₄₁₎	2,240 ₍₁₃₅₎	156 ₍₆₎
Turbidity, JTU	2 ₍₆₀₎	21 ₍₈₂₎	365 ₍₁₂₎	47 ₍₈₂₎	1 ₍₁₎
Calcium	33 ₍₂₃₃₎	45 ₍₄₃₉₎	112 ₍₂₁₈₎	77 ₍₂₉₇₎	16 ₍₆₀₎
Magnesium	5 ₍₂₃₂₎	12 ₍₄₃₉₎	52 ₍₂₁₈₎	24 ₍₂₉₇₎	4 ₍₅₉₎
Potassium	2 ₍₂₂₉₎	3 ₍₄₃₉₎	3 ₍₂₂₂₎	5 ₍₂₉₇₎	1 ₍₅₆₎
Sodium	14 ₍₂₃₃₎	25 ₍₄₃₉₎	95 ₍₂₁₈₎	53 ₍₂₉₇₎	4 ₍₅₉₎
Sulfate	36 ₍₂₃₀₎	85 ₍₄₃₉₎	497 ₍₂₁₇₎	170 ₍₂₉₇₎	9 ₍₅₈₎
Chloride	8 ₍₂₂₉₎	9 ₍₄₃₈₎	29 ₍₂₁₈₎	18 ₍₂₉₇₎	3 ₍₆₀₎
Iron, µg/L	212 ₍₂₄₎	61 ₍₅₅₎	1,859 ₍₄₉₎	183 ₍₂₃₎	30 ₍₁₎
SAR (Sodium Adsorption Ratio)	0.6 ₍₁₉₈₎	0.8 ₍₃₅₆₎	1.9 ₍₁₉₃₎	1.3 ₍₂₆₂₎	0.5 ₍₄₂₎
Bicarbonate	104 ₍₁₈₈₎	144 ₍₃₅₂₎	180 ₍₁₈₈₎	253 ₍₂₅₁₎	75 ₍₃₉₎
Hardness (CaCO ₃)	102 ₍₁₉₈₎	165 ₍₃₅₆₎	492 ₍₁₉₂₎	292 ₍₂₆₂₎	57 ₍₄₃₎
Dissolved Oxygen	10 ₍₇₇₎	9 ₍₂₅₀₎	9 ₍₂₄₎	10 ₍₁₀₇₎	10 ₍₁₆₎

¹ Total number of grab samples analyzed; not every parameter was analyzed in every sample.

² Total concentration; except as noted here, all reported values represent dissolved concentrations.

³ Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter.

⁴ Residue, water, filtered, sum of constituents, milligrams per liter.

All units are mg/L except as noted.

nm = not measured

₍₃₄₎ = Number of samples analyzed for that parameter.

3.17.2 Water Management and Monitoring

The RMPPA occurs in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984), the Upper Colorado River Basin groundwater region described by Freethey (1987), or Washakie Basin described by Collentine et al. (1981) and Welder and McGreevy (1966). Regional aquifer systems within the RMPPA are discussed by Heath (1984), Freethey (1987), and Driver et al. (1984). Basin-wide evaluations of hydrogeology specific to the ARPA have been investigated by Collentine et al. (1981). Groundwater resources include deep and shallow, confined, and unconfined aquifers. Site-specific groundwater data for the RMPPA are limited. Existing information comes primarily from oil and gas well records from the Wyoming Oil and Gas Conservation Commission, water-well records from the Wyoming State Engineer's Office (SEO), and from USGS (Weigel 1987). Extensive water quality surveys have been performed by USGS, which recently collected data in Carbon and Sweetwater Counties (USGS 2004; Bartos et al. 2006). Ground water quality conditions vary in the RMPPA and are defined by the geologic conditions in which the water is found.

Aquifers near the ground surface can be found in the Great Divide, Washakie, and Hanna Structural basins. The sediments in these basins contain many confining layers (aquitards), which are generally thick shales and extend over most of the structural basins. The Great Divide Structural Basin is a broad synclinal depression lying west of the Rawlins Uplift and generally north of I-80. North-south trending anticlines, the Rock Springs Uplift and the Rawlins Uplift bound the basin on the west and east. The basin is bound to the north by a series of major structural features and on the south by the Wamsutter Arch, which separates the Great Divide Basin from the Washakie Basin. The Washakie Structural Basin is a deep synclinal depression smaller in area than the Great Divide Basin. The Hanna Basin is a deep closed geologic basin containing sedimentary rock reaching a depth over 30,000 feet; it covers an area of approximately 1,750 square miles in the central portion of the RMPPA. Many of the areas outside of these structural basins contain isolated BLM-managed lands and, other than the higher elevation mountain areas, can be described by these areas.

Quaternary aquifers in these structural basins generally comprise alluvial deposits along major floodplains and isolated windblown and lake sediments. Groundwater flow within the sandy Quaternary aquifers is typically downward toward permeable underlying formations (Collentine et al. 1981). Ephemeral and intermittent drainages also often contain groundwater in the associated unconsolidated valley fills.

Tertiary aquifers in the RMPPA occur in the extensive North Park Formation, in the Browns Park Formation along the Little Snake River flood plain, and adjacent to the Sierra Madre Uplift and the Fort Union Formation, among others.

Aquifers near the surface are recharged from direct downward percolation of precipitation and snowmelt and from seepage losses from streams. Deep aquifers are also recharged by these processes in outcrop and subcrop areas and from slow leakage from overlying and underlying aquifers.

Ground-water recharge primarily originates as precipitation in the mountain areas surrounding the RMPPA where geologic formations outcrop or water resources were deposited during past geologic periods. Aquifers providing usable water in the RMPPA can be found along streams and rivers in the unconsolidated alluvium. These aquifers are termed unconfined, or water table, aquifers. Wells emanating from these aquifers can supply water to ranches and farms as well as to municipalities. Deeper confined aquifers supply water to artesian wells. Artesian wells may be flowing or not, depending on the potentiometric surface of the aquifer. Artesian wells can be used for domestic, municipal, and irrigation uses and are usually found where limestone or sandstone geologic formations are within 2,000 feet of the surface.

Groundwater quality in the RMPPA is highly variable, in part reflecting the complex geologic history of the region. In most areas within the RMPPA, the shallow groundwater is suitable for livestock. However, these waters can be only marginally suitable or even unsuitable for domestic or irrigation uses, mainly

due to high total-dissolve solids (TDS) concentrations. Groundwater tends to deteriorate as the distance from recharge sources and the ground surface increases. During its Sweetwater County water quality survey, USGS found high concentrations of sulfate, fluoride, boron, iron, and manganese in several shallow aquifers. Groundwater samples from the Battle Springs aquifer in the Great Divide Structural Basin had high radionuclide concentrations (USGS 2004).

Some of the local municipal water systems use groundwater for all or part of their supplies; these include Laramie, Rawlins, Elk Mountain, and Riverside (Appendix 11). Aquifers used for these supplies are generally in the foothills of topographic features such as Atlantic Rim (in the case of Rawlins) and the Medicine Bow Mountain Range for Elk Mountain and Riverside. Irrigation using groundwater also occurs using some of these same mountain-related aquifers. Livestock watering in these areas is typically a minor use.

Water Management

Water management within the boundaries of the RMPPA is primarily the responsibility of the Wyoming State Engineers Office, which administers state-held water rights, and the BOR, which administers dam and reservoir systems. BLM manages watersheds that supply irrigation water and water for other uses. Therefore, it is the RFO staff's responsibility to manage these lands in a manner that maintains water quality and quantity (USDI, BLM 1997). Other agencies involved in managing and regulating the water resources of the area are the local conservation districts, U.S. Army Corps of Engineers, EPA, WDEQ, and WGFD.

As noted above, the Wyoming State Engineers Office administers water rights within the State of Wyoming. Administration includes domestic, municipal, industrial, agricultural, recreational, and in-stream flow. The Wyoming Board of Control issues all water permits and decides all state water rights issues. All of the RMPPA is in Division One or Division Four as defined by the Wyoming Board of Control. Water rights in Wyoming are managed under the Prior Appropriation Doctrine, meaning "first in time, first in right."

All depletions identified from any BLM-approved activity in the Platte and Colorado River basins will be consulted on with USFWS according to the recovery or management plans for each basin as described in Appendix 11. By using the best available science, the RFO evaluates the potential for water depletions from oil and gas activities in consultation with USFWS. When fees to recovery programs are required as mitigation, they will be paid by the project proponent as a condition of approval.

BOR manages the system of dams on the North Platte River, beginning with Seminoe Reservoir, to meet the downstream requirements of irrigators, municipalities, industrial uses, and the States of Wyoming and Nebraska. BOR distributes water according to Wyoming water law and the Final Settlement Stipulation and Modified North Platte Decree. The Final Settlement, approved by the U.S. Supreme Court on November 13, 2001, modified the 1945 North Platte Decree and ended the Nebraska v. Wyoming lawsuit. This settlement established the North Platte Decree Committee (NPDC) and set in place new procedures for the administration and use of North Platte River water by Nebraska, Wyoming, Colorado, and BOR. The Supreme Court decision freed Wyoming to adjudicate water rights in the North Platte River drainage and to continue to collect data and accomplish tasks associated with the settlement. The North Platte River is still considered to be fully allocated, which limits new water development in the RMPPA from sources connected to surface waters. Typical water development associated with the RFO management actions involves troughs or pits for stock watering that must be permitted with the Wyoming State Engineers Office.

Interstate agreements, decrees, and treaties concerning water within the RMPPA include but are not limited to the following:

- **Colorado River Compact, 1922.** Divides the basin at Lee Ferry, Arizona, and provides that upper basin states may use 7.5 million acre-feet annually
- **Upper Colorado River, 1948.** Apportions 14 percent of the water allocated in the Colorado River Compact to Wyoming
- **Colorado River Basin Salinity Control Act, 1974 (P.L. 93-320).** Limits the amount of total dissolved salts flowing into Mexico; this was a result of Minute No. 242 (1973), an amendment to the 1944 treaty between Mexico and the United States
- **Laramie River Decree, 1922.** Allows the State of Colorado to divert 49,375 acre-feet of water from the Laramie River and its tributaries per calendar year for use in Colorado, of which 19,875 acre-feet may be diverted out of basin
- **Recovery Programs and Interagency Agreements.** Relate to water depletions in the Colorado and Platte River systems (Appendix 11).

BLM participates in efforts to manage and monitor water bodies listed on the 303(d) list, which flow through land or are located on land it administers. Streams on the 303(d) list are listed on the WDEQ webpage at <http://deq.state.wy.us/wqd/> and listed in Table S11-1 of the 303(d) list.

The Clean Water Act of 1987, as amended (33 United States Code 1251), established objectives to restore and maintain the chemical, physical, and biological integrity of the nation's water. The act also requires permits for point source discharges to navigable waters of the United States and the protection of wetlands, and it includes monitoring and research provisions for protection of ambient water quality. Protection of Wetlands (EO 11990) requires federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. Floodplain Management (EO 11988) provides for the restoration and preservation of national and beneficial floodplain values and the enhancement of the natural and beneficial values of wetlands in carrying out programs affecting land use.

In February 1998, President Clinton issued the "Clean Water Action Plan: Restoring and Protecting America's Waters." A key element in the Action Plan is the cooperative approach using the concept of watershed protection activities. The RFO often participates as a stakeholder in 319 EPA-funded projects designed to address water quality concerns on particular watersheds. This involvement typically yields changes in grazing management and could involve different recreation or transportation management or other changes in management actions designed to improve water quality. The Clean Water Action Plan calls for federal agencies to affirmatively engage watershed management as a core, guiding principle for water quality management. The principal goal of the "Riparian-Wetland Initiative for the 1990s" is to restore and maintain riparian-wetland areas. This initiative continues, and the goal of obtaining PFC for all riparian-wetland areas on BLM-administered land is contained in the Standards for Healthy Rangelands (Appendix 8).

Water Monitoring

Water resource monitoring in the RMPPA is designed and managed to provide BLM with baseline information on water quantity and quality as well as to answer project-specific questions. Monitoring activities include the collection of streamflow data and water samples for analysis, evaluation of stream health conditions, evaluation of springs and other water sources, and evaluation of streamflow conditions. In addition to the PFC assessments discussed in Section 3.15.3, which are indirect indicators of water quality and watershed health, direct methods are used to monitor water resources. Direct methods include

gaging stations (Table 3-36), water quality samples, and bioassessment protocols. Within the RMPPA, water quality samples historically have been collected at springs, wells, stream locations, ponds, and ephemeral washes. A watershed approach to water quality assessment in the RMPPA is used. Ground water monitoring occurs at several wells in the project area, with grab samples being collected periodically (Appendix 11 and 17).

Bioassessment protocols developed by WDEQ provide quantitative assessments on watershed health and ecosystem integrity. The RMPPA is implementing the WDEQ protocols and developing an integrated approach to the monitoring and assessment of watershed, aquatic, and riparian ecosystem conditions within areas that are reviewed for Rangeland Standards and Guidelines.

Rangeland Standard 5 is met when water quality meets state standards. In the past, only streams listed on the State's 303d list for impaired waters were said not to meet this standard. In 2005, 15 sites were selected to evaluate the seven watershed areas that are used for the periodic standards assessments. At each of these sites, three permanent cross-sections were established, flows were measured, pools were sampled for sediment deposition, water quality samples were taken, a green-line survey was performed to collect quantitative information about riparian vegetation, and macroinvertebrates were sampled. These sites will be visited before standards assessments to better characterize water quality. Sites were selected on perennial streams that have a preponderance of BLM-managed land upstream. This monitoring project collects data similarly to the State of Wyoming's BURP Protocol, collecting chemical, physical, and biological samples and assessing the relative health of the system. Management of aquatic habitats on BLM-administered land would be according to BLM Manual 6720 (Appendix 11).

These collective monitoring efforts are helpful in providing information that is used to adjust management within the watersheds and along riparian areas. Information is also shared with WDEQ for listing or delisting water bodies on the 303(d) list. Assessments under the BLM Standards and Guidelines using a watershed approach are conducted on a 10-year cycle. The RFO staff began this watershed approach in 2001, and it plans to complete the first round of these assessments in 2008. Initial efforts have concentrated on watershed management areas in the western portion of the RMPPA, where BLM-managed lands are most extensive.

3.17.3 Soils

Soil data have been used by BLM as a basis for decisions concerning range sites, range improvements, and wildlife habitat sites and for determining reclamation practices to address surface disturbance due to mineral development. In addition, soil data have been used to locate sources of gravel and to determine the suitability of areas for use as water disposal pits for water produced from gas wells (USDI, BLM 1987). Order 3 soil surveys are not sufficiently detailed for many land management decisions and are in need of updating. In the sections below, the soil types found within the RMPPA are identified and discussed, along with specific conditions and trends. Watershed health standards are evaluated during Standards for Healthy Rangelands assessments (Appendix 8).

Soil Conditions and Characteristics

Soils in the RMPPA vary. They include shallow-to-deep and fine-to-coarse-textured soils. They vary in salt content, organic matter content, and parent material. Map 3-12 delineates soil zones based on precipitation zones within the RMPPA for which generalizations can be made about soil productivity, permeability, infiltration, stability and strength, and erosion potential. These areas are distinguished by varying amounts of precipitation, elevation, soil temperature, and soil parent material (USDI, BLM 1987). General conditions found in soils within Map Units A through F on Map 3-12 are discussed in more detail in the following sections. These conditions collectively influence watershed function and the development of healthy vegetation, which together enable human uses and provide wildlife habitat.

Soil Productivity

Soil productivity is the most important soil value in the RMPPA because it determines stocking rates for livestock through the amount of vegetation produced, it dictates the kinds of plant communities on which wildlife habitat is based, and it determines reclamation potential in areas of surface disturbance. Most soils in the RMPPA support vegetation that is used by livestock and that also serves as wildlife habitat. Soil characteristics and environmental factors that affect soil productivity include organic matter content, salt content, amount of precipitation, soil temperature, aspect, soil depth, and soil parent material.

Soil productivity is naturally low throughout the RMPPA, although it is higher around springs and along natural drainage ways (USDI, BLM 1987). Productivity varies depending on a number of factors, including soil depth, texture, topographic slope, slope aspect, and permeability. However, variability in the amount of precipitation is the main factor in variations in soil production within the RMPPA. Within the RMPPA, Map Unit A (shown on Map 3-12) receives the least precipitation, and Map Unit C receives the most. The more precipitation an area receives, the more vegetative cover is present. Vegetative cover contributes organic matter to the soil, which in turn provides nutrients for plants, stores more moisture, and improves soil structure—all of which promote vegetative growth.

Map Units C and F have soils with thicker and darker surface horizons, indicating higher organic matter content. The darker surface horizons are due to the higher amount of vegetation typically found within these areas, and to colder temperatures in the case of Map Unit C. Colder temperatures slow the decay of organic material, thus allowing more organic matter to accumulate. The warmer temperatures in Map Unit F create a longer growing season, thus allowing more vegetation to grow and plants to produce more vegetative material. Map Units B, D, and E contain more organic matter than does Map Unit A, although none of these units has the dark surface layer (USDI, BLM 1987).

Other factors that affect productivity are depth to bedrock, crusting, and nutrient content. Soils in the RMPPA are generally shallow, with a depth to bedrock of less than 20 inches occurring in all map units, and occurring most in Map Unit C and least in Map Unit D. This restricts root penetration and lowers water-holding capacity, because water tends to run off these areas faster than it infiltrates. Crusting, which results from a breakdown in soil structure caused by high sodium content and raindrop impact on bare areas, reduces water infiltration and thereby salt leaching and root penetration. This occurs particularly in Map Unit A but can also occur in Map Units B, C, E, and F. Nitrogen and potassium are adequate for plant growth throughout the RMPPA, but phosphorus is limited.

As a result of all these factors, Map Unit A has the lowest overall soil productivity; Map Units B, D, and E are intermediate in production; and Map Units C and F have the highest soil productivity (USDI, BLM 1987). Bottomland and stream terrace soils are the most productive, but limitations include alkalinity, high clay content, low permeability, and flooding. Upland soils are moderately productive. Limitations include shallow depths, low permeability, and alkalinity. The productivity of dissected upland soil is unknown but is likely to be low. Playa productivity may be high if salinity is not a limiting factor.

Soil Permeability

The permeability of a soil affects its use for reservoirs, water disposal pits, sanitary landfills, and sewage lagoons. Such facilities require soils that are either impermeable or just sufficiently permeable to filter out impurities before the leached water reaches natural surface or ground water. The soils in Map Unit A are generally fine in texture and are either sufficiently impermeable to effectively hold or filter water or can be compacted to function as such. Map Units B, C, E, and F are less effective at holding or filtering water, but they can be aided in fulfilling this function through compaction. Map Unit D soils are very permeable, and even compaction does not enable them to hold water. For any of these soils, if the underlying bedrock (typically within 60 inches of the surface) is fractured, the ability of the soil to contain water is markedly diminished. Piping (formation of tubular cavities) may also reduce the containment capacity of Map Unit

A, where gypsum seams have been dissolved or wet-dry cycles have produced cracks in clays. Finally, the containment capacity of Map Units A, B, C, E, and F may be diminished adjacent to major drainages where strata of coarser materials, which are permeable and typically not good filters, may be embedded with finer materials.

Soil Strength and Stability

Soil strength is an important consideration during construction of roads and facilities because low-strength soils are subject to deformation. In areas of low soil strength, building foundation stability is low, and roads and drill pads can become rutted and slippery when wet. Soils composed predominantly of one particle size exhibit low strength. Soils containing a variety of particle sizes exhibit the greatest strength because they better fill in voids of varying sizes, causing more friction among particles. In the RMPPA, soils within Map Unit A have low strength. Map Units B, C, E, and F have moderate strength; these textures are typically loamy, and compaction may be possible to increase strength and reduce the potential for deformation under a load. Soils in Map Unit D and portions of Map Unit A are sandy; because these soils are loose, they are subject to displacement under dry conditions. In Map Unit A, many soils have clayey or silty textures, making compaction difficult and creating deformation upon wetting under a load (USDI, BLM 1987).

Soil stability problems occur in Map Units A, B, E, and F, but Map Unit C has the greatest stability problems. Map Unit C receives the greatest amount of precipitation, primarily in the form of snow. Soil becomes saturated from snowmelt, which increases soil weight. This can cause mass wasting, which is the downslope movement of rock and soil under the influence of gravity (USDI, BLM 1987).

Soil Erosion

Accelerated rates of erosion do occur within localized areas, including areas of surface disturbance and some drainage areas, especially riparian areas where animals tend to congregate. Reduced vegetation along drainage ways tends to destabilize stream banks and contribute to stream downcutting and gulying. Accelerated stream bank erosion has historically occurred within the RMPPA in numerous locations, including the Muddy Creek, Sage Creek, Second Creek, and Third Sand Creek watersheds (USDI, BLM 1987).

Within the RMPPA the highest soil erosion rates occur within Map Unit A as a result of naturally low vegetative cover, soil crusting, low organic matter content, and soft shales that are susceptible to erosion. These characteristics are especially apparent in the Muddy Creek drainage. Because of greater vegetative cover and organic matter content and lower sodium content, rates of water erosion are lower in Map Units B, E, and F and lowest in Map Unit D. Map Unit D is susceptible to wind erosion; although it is protected by good vegetative cover, it could actively erode if vegetative cover were reduced. Wind erosion also occurs in Map Units A, B, C, E, and F, but at lower rates (USDI, BLM 1987).

In addition to the soil erosion that occurs in the generalized map units discussed above, stabilized intermittent sand dunes are present in hilly upland areas within the RMPPA. For example, the RMPPA contains the Sand Hills area, which is a unique and fragile dune area with diverse vegetation. BLM management objectives include protection of the unique vegetation complex and minimization of soil erosion. In addition, there is a band of frequently active sand dunes north of Seminole Reservoir and stretching across the northern portion of the RMPPA. Dune Ponds, also within the RMPPA, is a 150-acre area consisting of large sand dunes. These scattered areas of sand dunes are easily eroded by wind when vegetation is removed.

Soil Salinity

Soluble salt levels affect management potentials as a result of toxicity, reduced infiltration rates, limits on nutrient availability, and reduction of water available to plants. Major causes of increased salinity

contribution from public lands include overgrazing, OHV use, and energy exploration and extraction. These activities compact the soil surface and cause a reduction in plant cover, creating increased runoff carrying salt-laden sediments into drainages (USDI, BLM 1996). In addition, deteriorated riparian conditions can eventually convert perennial streams into ephemeral drainages where seasonal water tables fluctuate (Wichers 2002), as discussed in Section 3.15.3.

Salts in the soil stress plants by making water uptake more difficult. More precipitation received in an area translates into more moisture available to leach salt out of the rooting zone. Areas in which soils are sufficiently leached can produce good vegetative cover.

Varying concentrations of soluble salt in soil occur throughout the RMPPA. Leaching occurs the most in Map Units C, D, and F, and the least in Map Unit A. Map Units B and E have soils that are sufficiently leached to produce good vegetative cover (USDI, BLM 1987).

3.18 WILD HORSES

Following passage of the Wild, Free-Roaming Horse and Burro Act in 1971, BLM identified six areas used by wild horses within the current RMPPA. The following three herd areas failed to meet the criteria for suitably maintaining a healthy population of wild horses in accordance with the intent of the Act: Bolten, Checkerboard South, and Muddy Creek (subsequently known as “Doty Mountain/Cherokee”). Management of horses in these areas was not considered for the following reasons:

- The area was more than 50 percent privately controlled land, and the private landowners showed no interest in having their lands included in an HMA.
- Most of the horses were privately owned and claimed.
- Fencing and other barriers precluded free movement of wild horses to year-round habitat.

Land ownership and current conditions have not changed significantly since these decisions were made; however, these areas still maintain their herd area status according to the Act. Horses in these herd areas were removed.

A brief history of Wyoming BLM management of wild horses is contained in Appendix 12.

The following three herd areas were determined to be able to support viable healthy populations of wild horses: Sand Creek (later renamed “Adobe Town”), Stewart Creek/Chain Lakes, and Cyclone Rim (later renamed “Lost Creek”). Three HMAs currently correspond to these three herd areas. Wild horses that leave designated HMAs are considered excess and are removed.

3.18.1 Herd Management Areas

The following paragraphs briefly describe the habitat and wild horses in the three identified HMAs within the RMPPA.

Adobe Town HMA

The Adobe Town HMA is located in south-central Wyoming between I-80 and the Colorado-Wyoming border (Map 2-21). Topography in the area is varied, with everything from colorful eroded desert badlands to wooded buttes and escarpments. In between these two extremes are extensive rolling-to-rough uplands interspersed with some desert playa and vegetated dune areas. The Adobe Town WSA is contained entirely within the Adobe Town HMA. Off-road restrictions and difficult terrain within the WSA provide a relatively undisturbed location for wild horses.

Total acreages for the HMA are shown in Table 3-40. It should be noted that 6.1 percent of the HMA is deeded or Wyoming state lands. These privately controlled lands are generally unfenced and freely available to the horses. A disproportionate share of the dependable water sources occurs on these lands. Typically, these lands are controlled by the grazing permittee(s) in the area and used in conjunction with their public grazing operations.

Table 3-40. RMPPA Wild Horse Appropriate Management Levels and Populations

Area	Public Acres	Other Acres	AML	Average Rate of Annual Increase	Current Estimated Population ¹
HMAs					
Adobe Town	420,000	28,000	700	16%	839

Area	Public Acres	Other Acres	AML	Average Rate of Annual Increase	Current Estimated Population ¹
Lost Creek	235,000	15,000	70	18%	143
Stewart Creek	215,000	16,000	150	18%	129
HMA Totals	870,000	59,000	920	-	1,111
Other Areas Affected by Wild Horses					
I-80 North	359,000	195,000	0	24%	19
I-80 South	333,000	356,000	0	23%	111
Bairoil Pasture	6,000	1,000	0	_ ²	_ ²
Other Areas Total	698,000	552,000	0	-	130
Total of All Areas	1,568,000	611,000	920	-	1,241

¹ Population estimate as of December 31, 2003.

² Wild horses in the Bairoil Pasture of the Stewart Creek allotment are managed with the excess wild horses in the I-80 North area.

Source: BLM, 2003.

Plant communities are very diverse in this large area. The most abundant plant community in the HMA is sagebrush/bunchgrass. Other plant communities present are desert shrub, grassland, mountain shrub, lentic riparian grass/sedge, juniper woodlands, and a very few aspen woodlands. Limited, sensitive desert riparian areas are important features in the landscape, as they provide much needed water resources for wild horses and wildlife.

The appropriate management level (AML) for wild horses in the Adobe Town HMA is 700 adult animals (610–800 management range) plus the unweaned colts of the year. It is estimated that there are currently around 839 wild horses in the HMA (Table 3-40). These horses have averaged a rate of annual increase of 16 percent per year. Genetically, wild horses in the Adobe Town HMA descend from domestic breeds such as escaped domestic saddle stock from surrounding populated areas.

Stewart Creek HMA

The Stewart Creek HMA is located in the west-central portion of the RMPPA, along the northern border (Map 2-21). It is traversed in a north-south direction by the Continental Divide, along Lost Soldier and Bull Springs rims. Adjacent to these rims on either side are strongly rolling uplands. These areas transition to the gently rolling uplands that comprise the majority of the HMA. Although annual precipitation varies between just under 7 inches to more than 10, most of the precipitation occurs as snow.

The most abundant plant community in this HMA is sagebrush/bunchgrass. Other communities present are desert shrub and grassland, with limited lentic riparian grass/sedge, juniper woodland, mountain shrub, and desert willow riparian types. Wild horses in the area have proven to be very adaptable to changes in their environment. During harsh winters they get by on coarse woody vegetation in place of grass (USDI, BLM 1994). Limited, sensitive desert riparian areas are important features in the landscape, as they provide much-needed water resources for wild horses and wildlife.

Total acreages for the HMA are shown in Table 3-40. It should be noted that 6.6 percent of the HMA is deeded or Wyoming state lands. These privately controlled lands are generally unfenced and freely available to the horses. A disproportionate share of the dependable water sources occurs on these lands. Typically, these lands are controlled by the grazing permittee(s) in the area and used in conjunction with their public grazing operations.

The AML for wild horses in the Stewart Creek HMA is 150 adults (125–175 management range) plus the unweaned colts of the year. It is estimated that there are 129 wild horses in the HMA (Table 3-40). The horses in the HMA have averaged a rate of annual increase of 18 percent per year. The wild horses in the HMA are assumed to have been influenced by the routine escape of domestic saddle stock from the surrounding areas. Genetic testing on horses from the west side of the Lost Soldier Divide has shown them to have some genetic characteristics of the Spanish Colonial Horse.

Lost Creek HMA

The Lost Creek HMA is located in the northwest corner of the RMPPA (Map 2-21). The HMA is joined on the east by the Stewart Creek HMA, on the north by the Antelope Hills HMA, and on the west by the Divide Basin HMA. The RMPPA does not manage the latter two HMAs. The Lost Creek HMA lies within the Great Divide Basin, a closed basin out of which no water flows.

Some desert playa and vegetated dune areas are interspersed throughout the HMA. The most abundant plant community in this HMA is sagebrush/bunchgrass. Other plant communities present include desert shrub, grassland, and lentic riparian grass/sedge primarily associated with desert wetland areas. Several sensitive desert wetland/riparian areas occur throughout the area, including both intermittent and perennial lakes and streams.

Total acreages for the HMA are shown in Table 3-40. It should be noted that 6 percent of the HMA is deeded or Wyoming state lands. These privately controlled lands are generally unfenced and freely available to the horses. A disproportionate share of the dependable water sources occurs on these lands. Typically, these lands are controlled by the grazing permittee(s) in the area and used in conjunction with their public grazing operations.

Genetic testing on the wild horses in the Lost Creek HMA has shown the horses carry a high percentage of genetic markers identified with the New World Iberian (Spanish Colonial) breeds. The Roger's genetic similarity index (a common index used to determine genetic similarity of various breeds) for the wild horses from the Lost Creek HMA was quite high (.845) for the New World Iberian breeds. In other words, the horses in the Lost Creek HMA are genetically more similar to the Spanish Mustang and other New World Iberian breeds than they are to other breeds, such as the American Quarter Horse or the Morgan. This characteristic makes the horses in the Lost Creek HMA unique among the wild horse herds of Wyoming tested so far. The small size of the Lost Creek wild horses positions them rather precariously, in genetics terms, for losing their unique marker through mixing with other wild horses. Fortunately, the Stewart Creek horses on the west side of the Lost Soldier Divide are genetically similar, with a Roger's genetic similarity of .818 to the New World Iberian breeds, and therefore do not represent a significant threat to this genetic resource.

The AML for wild horses in the Lost Creek HMA is 70 adults (60–82 management range) plus the unweaned colts of the year. It is estimated that there are currently 143 wild horses present in the HMA. The horses in the HMA have averaged a rate of annual increase of 18 percent per year.

3.18.2 Other Areas Affected by Wild Horses

In addition to the three HMAs identified above, areas adjacent to these HMAs are affected by wild horses. As competition for resources within HMAs increases, some wild horses venture outside of HMA boundaries in search of forage and water resources. These horses are considered excess and are removed. There are areas to which wild horses commonly venture, including I-80 North below the Stewart Creek and Lost Creek HMAs, I-80 South above the Adobe Town HMA, and the Bairoil pasture of the Stewart Creek allotment northeast of the Stewart Creek HMA. Populations of horses in these areas are shown in Table 3-40.

Wild horse population fluctuations are influenced not just by the reproductive increases of wild horse populations, but also by their contact with other horse herds outside the RMPPA HMAs. These meta-populations provide increased genetic material to maintain viable populations. Table 3-41 shows the meta-populations of which the wild horses of the RMPPA are a part.

Table 3-41. Wild Horse Regional Meta-Populations Associated with the RMPPA

RMPPA HMAs		Meta-Populations		HMA(s) in the Meta-Populations	Type of Interaction	Points of Contact
Name	AML	Name	AML			
Adobe Town	700	Stateline	1,250	Adobe Town Salt Wells Creek Sand Wash (CO) ²	Male migration, female exchange	Haystacks, Alkali, Sand Creek, Powder Wash
Stewart Creek	150	Red Desert ¹	790	Stewart Creek Lost Creek Antelope Hills Divide Basin Green Mountain Crooks Mountain	Male migration, female exchange	Hay Reservoir, Bare ring, Hadsell, Osborne Draw
Lost Creek	70	Red Desert ¹	790	Stewart Creek Green Mountain Crooks Mountain Lost Creek Antelope Hills Divide Basin	Male migration, female exchange	Hay Reservoir Bare Ring, Hadsell, Osborne Draw

¹ Wild horses from the Sweetwater meta-populations (Green Mountain HMA and Crooks Mountain HMA) occasionally mix with wild horses in the Red Desert meta-populations.

² Sand Wash HMA is located entirely in Colorado, within BLM's Craig Field Office. Although managed by Colorado BLM, horses from the Sand Wash HMA provide biologically and genetically important interactions with horses from the other HMAs in the meta-populations.

Management of wild horses in the RMPPA is guided by the RFO Wild Horse Management Handbook. The handbook contains policy, practices, procedures, and technical support documentation that affect wild horse management. Specifically, the handbook contains guidelines for wild horse management, such as how AMLs are monitored and adjusted, in addition to other wild horse management practices.

3.18.3 Wild and Free-Roaming Nature (of Wild Horses)

In addition to population objectives and habitat conditions addressed by most of BLM's wild horse management efforts, another aspect of wild horses is important, especially when considering the interactions of horses and other resource uses. This aspect is what makes a particular wild horse population wild and separates it from domestic horses roaming in a fenced pasture—its wild, free-roaming nature. Appendix 12 contains a detailed discussion of that important aspect of wild horses.

3.19 WILDLIFE AND FISH

This section focuses on those wildlife and fish species in the RMPPA that are of particular interest or importance to the public or the ecosystem because they are used in some way (hunted, observed, photographed, etc.), have intrinsic value, or have populations that are at potential risk (threatened, endangered, or of special concern). The millions of acres of varied BLM-managed lands within the RMPPA provide important habitat for wildlife and fish species, especially where such lands and the waters they contain occur in large unfragmented tracts and reaches.

3.19.1 General Wildlife

Terrestrial wildlife species, to the extent that they are managed, are overseen by state and federal wildlife management agencies. The State of Wyoming has jurisdiction over all wildlife in the state, placing species under management of either WGFD or the state Department of Agriculture. WGFD is responsible for oversight of big game species, nongame species, and small game species that are non-migratory. The USFWS has oversight of migratory bird species, whether they are hunted (e.g., waterfowl) or not (e.g., passerine species such as warblers and sparrows), and of all federal threatened, endangered, proposed, or candidate plant and animal species. WGFD participates in these activities. However, BLM manages millions of acres of habitat that support these wildlife species, and thus has an integral role in their ecological health and viability. Many of the species groups under USFWS regulations also receive management and protection under state statutes and regulations.

Wildlife habitat is best characterized by the vegetation types discussed in Section 3.15 and the water resources discussed in Section 3.17, although air quality (Section 3.2), geology and topography (Section 3.8), and soils (Section 3.17) are also important contributors to habitat character. Such factors as fire management; Forest Management; rights-of-way; livestock grazing; oil, gas, and other energy developments (e.g., windpower and coal mining); OHV use and other recreation; and wild horses also influence the quality of habitat, as do management actions applied throughout BLM-administered lands and in SD/MAs. Wildlife species generally use vegetation on the basis of its physiognomy (e.g., structure [height and spacing] and growth form [gross morphology and growth aspect] of the predominant species, and leaf characteristics of the dominant or component plants). This means that a given species may use a shrub of a particular height and growth form irrespective of its species. Therefore, the mapping of vegetation zones (Map 3-10) characterizes wildlife habitat in general terms. Especially important habitats are mountain shrub (mountain big sagebrush and antelope bitterbrush); monotypic stands of bitterbrush and true mountain mahogany; and coniferous, rockland, aspen, riparian, and lowland sagebrush (primarily Wyoming big sagebrush on flatlands and basins below 7,000 feet) (Wichers 2002).

As is apparent from the vegetation map, the habitat diversity within the RMPPA is extreme, ranging from alpine barren areas in the Sierra Madre and the Snowy Range in the south-central portion of the RMPPA to desert barren areas in the Red Desert in the southwestern portion, with extensive grassland, shrub, and forest/woodland communities in between. The most historically important of these habitat types, on the basis of total species, number of breeders, number of sensitive species, and availability, are open aquatic, riparian (grassland, willow-waterbirch, aspen, and cottonwood), mountain shrub, juniper, aspen, aspen/conifer, ponderosa pine, Douglas fir, rockland in the Laramie Peak and North Platte Valley, and wet forested meadow (USDI, BLM 1987). The vegetation zones and plant community classes currently recognized in the RMPPA are discussed in Section 3.15. As noted above, the community classes that are most important are those associated with climate or water availability, the less abundant and more diverse shrub classes such as mountain shrub, deciduous woodland and forest classes, the less abundant coniferous classes such as ponderosa pine and Douglas fir, and areas of interspersed deciduous and coniferous trees. Within each vegetation zone, similar wildlife species will be found, although individual species will tend to prefer vegetation of a particular height and density. Within this preferred area,

individual plants of a particular age or life stage may also be preferred. Thus it is important to manage each vegetation zone for maximum diversity in terms of age, height, and density so that the biodiversity and ecological health and resilience of the plant communities and their wildlife inhabitants are maintained. At the same time, excessive fragmentation of vegetation zones is to be avoided so that wildlife species requiring large tracts of a similar physiognomic type can complete their life cycles.

More than 374 vertebrate species have been documented in the RMPPA (USDI, BLM 1987). The vertebrate wildlife species that occur represent all major vertebrate classes: amphibians, reptiles, birds, and mammals. Fish are discussed in this section. Data are available primarily for birds, mammals, and fish because of particular interest in them by the hunting, fishing, and recreating public and by natural resource specialists. However, there are some data available for amphibians and reptiles. The most important of the previously mentioned species are discussed below.

Small mammals within the RMPPA include cottontails, jackrabbits, snowshoe hares, squirrels, ground squirrels, mice, voles, and shrews. Other species within the area include badger, bobcat, marten, weasel, coyote, raccoon, red fox, swift fox, gray fox, skunk, beaver, mink, and muskrat.

Nongame species include all species or groups not discussed above. Such species are numerous and diverse, especially given the range of habitats present in the RMPPA. Because of limitations of knowledge, space, time, and general interest, only a few of these species or groups are addressed below. Each has an important and long-term association with the RMPPA. The hundreds of additional bird species that inhabit the RMPPA for all or a part of their life cycles are important components of the ecosystem and an important focus of the large segment of recreationists who enjoy bird watching. The diversity of these species is supported by the wide range of habitats present within the RMPPA. BLM is a participant in the Wyoming Partners In Flight, and specific biological objectives and recommendations for land birds are presented in the Wyoming Bird Conservation Plan and incorporated into BLM management of federal land.

Raptor Habitat

Raptors (birds of prey) found in the RMPPA include eagles, falcons, hawks, harriers, and owls. These species occupy an ecological position at the top of the food chain and, therefore, act as biological indicators of environmental quality because they are fewer in number, have longer reproductive cycles, and are more prone to bioaccumulation. Most of these species are also sensitive to disturbance, especially during their nesting cycles. Some species of raptors concentrate their nests on suitable strata along cliffs or other formations and use such sites year after year unless disturbed.

Raptors within the RMPPA area include hawks, kites, eagles, and falcons; however, kites are incidental to the region. These birds are medium-sized to very large diurnal with hooked beaks for tearing flesh and strong legs and sharp talons for grasping, holding, and in some cases killing their prey. They are generally colored to blend in with their environment. Members of this family have eyesight that is four to eight times better than that of humans, enabling them to spot prey from great distances (Sibley 2001). Owls and harriers are also considered raptors and nest within the RMPPA. Nesting sites for these species include cliffs, trees and shrubs, cavities, rock outcrops and ground substrate, and man-made structures. Most species build substantial stick nests, may re-use the same or alternate nests within their territory, and may switch nests occasionally in years after brood failure.

In the RMPPA, concentrations of ferruginous hawks or golden eagles and prairie falcons (depending on the nesting substrate) have been identified in the past at Shamrock Hills, Brown Canyon Rim, Seminole, Red Rim, Atlantic Rim, Cherokee, Muddy Creek, Doty Mountain, Delaney Rim, Bolten Rim, Hanna, and Platte-Divide (USDI, BLM 1987). Identification of these nesting concentrations was based in part on a

raptor study that began in 1975² and that has continued through the present, resulting in extensive documentation of raptor nesting in the RMPPA.

The intensity of this study has varied in response to proposals for development in the RMPPA. Extensive data were collected in the Shamrock Hills area beginning in 1988 in response to potential development of coalbed gasification. These efforts were renewed in 1997 through 2001 and are ongoing (Apple 2002a). In addition, beginning in 1998, extensive data collection was initiated in an area about 25 miles west of Rawlins and extending both north and south of I-80 in the vicinity of Wamsutter (Apple 2002a), where natural gas development occurs. An associated study focuses on the use of artificial nest sites (a project begun in 1988), and there is also a ferruginous hawk banding program (begun in 1993) (Apple 2002b).

The long-term database on nest locations is very effective in characterizing the raptor species that nest in the RMPPA and their nests. The data show not only the relative number of nests of each species, but the height and type of substrate on which they are built. This study provides extremely well-documented information on many of the species, especially the ferruginous hawk, which has been the primary focus of this effort. Of the total nests, 54.3 percent were on BLM-managed public land and 37.4 percent were on private land, with the remainder on USFS, state, other, or unrecorded land ownership types. The more focused portions of this overall study provide extensive additional data. For example, between 1998 and 2001, active ferruginous hawk nests were more often successful on artificial nest sites (81 percent) than on natural nest sites (65 percent). Overall nesting success for active nests of all species was 85.5 percent based on 2001 data, while in the Shamrock Hills Study Area, Continental Divide/Wamsutter II North of I-80, Continental Divide/Wamsutter II South of I-80 (Northern Segment), Continental Divide/Wamsutter II South of I-80 (Southern Segment), and other incidental areas, success of active nests was 92 percent, 80 percent, 80 percent, 93.9 percent, and 78.3 percent, respectively (Apple 2002b). These areas were undergoing varying degrees of development at the time these data were collected. The Jep Canyon ACEC was established in part to maintain the productivity of nesting raptor pairs (USDI, BLM 1990a), as was the Shamrock Hills ACEC.

Data have also been collected on prey items noted in ferruginous hawk nests between 1993 and 2001 (Apple 2002b). Wyoming ground squirrels are by far the predominant prey species. Other prey species recorded at least once on the basis of prey remains were 13-lined ground squirrel, vole, sagebrush vole, cottontail rabbit, least chipmunk, prairie dog, western harvest mouse, short-tailed weasel, white-tailed prairie dog, northern pocket gopher, greater sage-grouse, horned lark, sparrow species, and other songbirds. Voles, cottontails, and prairie dogs were regular if not frequent prey items. The remaining prey species appear to be incidental food items.

Nest locations are not shown in the RMP maps in order to protect these sensitive areas.

Waterfowl and Other Shorebird Habitat

Ducks and geese occur in aquatic areas throughout the RMPPA. Some individuals or species breed, winter, or remain year-long in the state, while larger numbers pass through the RMPPA on spring or fall migration. The RMPPA includes the Central Flyway (east of the Continental Divide except for the Great Divide Basin) and the Pacific Flyway (west of the Continental Divide and the Great Divide Basin). Most of these species depend on wetlands or open water that is sufficiently shallow to support rooted vegetation, and they feed on the biotic communities developed in such habitats. Many species feed on insects and small fish or amphibians in addition to, or instead of, plant foods in these aquatic areas. Species that primarily eat fish may feed in deeper water where there is insufficient light to support rooted vegetation. In addition, some species feed frequently on upland grasses and forbs in grassy fields and meadows that provide succulent vegetation, that are sufficiently open to enable rapid flight, and that do

² Only three records in the database predate this year.

not harbor predators. Such habitats support waterfowl and other shorebirds year-round. Nesting cover is an important attribute for both upland and riparian nesting species.

The various natural lakes, constructed reservoirs, and streams within the RMPPA provide important habitat for waterfowl and other shorebirds. The most important of the lakes and reservoirs are Seminole Reservoir, Pathfinder Reservoir, Bucklin Reservoir, Shirley Basin Reservoir, Teton Reservoir, Little Sage Creek Reservoir, Flowing Well Reservoir, Wheatland Reservoir, Lake Hattie, Cooper Lake, James Lake, and the Muddy Creek wetlands complex, but even small pits, reservoirs, and playa lakebeds provide important habitat when adequate water is available. Development of water sources in normally dry desert regions has created habitat and increased production of waterfowl and other bird species. Because of unlimited nesting habitat in the rangelands around these waters (compared to farming around prairie potholes), nesting success and brood sizes are often larger. In addition, pools in the numerous streams and their tributaries provide important habitat. Only some of these aquatic resources are on BLM-managed public land.

Neotropical Migratory Bird Habitat

The United States has ratified international conventions regarding the protection of migratory birds. The Migratory Bird Treaty Act (MBTA) of 1918 (16 USC 703-711) implements the protective measures of these conventions. The MBTA prohibits “taking,” which is the killing, possession, or transport of any migratory bird or its eggs, parts, or nests except as authorized by a valid permit. These actions may be permitted only for educational, scientific, and recreational purposes, and harvest is limited to levels that prevent overutilization. Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, was issued in January 2001 and emphasizes that federal actions are subject to the MBTA. It directs federal agencies (such as BLM) to evaluate the effects of agency actions in National Environmental Policy Act (NEPA) documents like this final EIS.

Under the MBTA, permits can be issued by USFWS for the intentional take of specific birds and nests that have been identified prior to application for the permit; however, no permits can be issued for take that is incidental to the action being taken (i.e., incidental take). For example, if by constructing a livestock water development an active migratory bird nest is destroyed, the action would constitute an “incidental take” of the nest where the intent of the action was not to destroy the migratory bird nest but to construct a livestock water development. Therefore, taking the nest is incidental to constructing the development.

All migratory bird species likely to be found within the RMPPA are protected under the MBTA, with the exception of the house sparrow, European starling, Eurasian collared dove, and rock dove. Any incidental take of these protected species (except the house sparrow, European starling, Eurasian collared dove, and rock dove) would constitute a violation of the MBTA.

Upland Game Bird Habitat

Upland game birds in Wyoming that are native to the state include blue grouse, ruffed grouse, greater sage-grouse, sharp-tailed grouse, and mourning doves. Upland game birds that are introduced include pheasant, chukar, gray partridge, and turkey. Greater sage-grouse are an important indicator species, especially on BLM-administered lands. Greater sage-grouse are discussed in the BLM Wyoming State Director’s Sensitive Species List section of this document. BLM habitat management is directed toward native species.

There are two species of grouse and one sub-species that are known to occur within the RMPPA. These species include the plains sharp-tailed grouse and the blue grouse. The Columbian sharp-tailed grouse is a sub-species of the plains sharp-tailed grouse. Columbian sharp-tailed grouse are discussed in the BLM Wyoming State Director’s Sensitive Species List section of this document.

The range of the plains sharp-tailed grouse extends eastward from the divide. The current range of the plains sharp-tailed grouse includes eastern Wyoming, northeastern Colorado, and portions of Nebraska. This species has the potential to occur throughout the eastern portion of the RMPPA wherever remnants of appropriate habitat occur. In Wyoming, the populations are highest in Goshen County and eastern Platte and Laramie Counties. The optimum habitat includes an interspersed of plant communities with extensive ecotones, including grassland, grassland-shrub mixtures, and mixed-grass prairie occasionally broken by brushy draws. Dancing grounds are located in these mixed shrub-grassland habitats, and broods are reared in habitats where shrubs are interspersed with dense herbaceous cover. Wintering habitat includes aspen parklands and stands of chokecherry, aspen, cottonwood, green ash, and willow, especially when the snow is deep.

Blue grouse are found primarily in the Ferris and Seminoe Mountains, the Laramie Peak area, and throughout forest fringes associated with the Medicine Bow National Forest. Blue grouse tend to use habitat that contains mountain shrubland, aspen/conifer woodland, aspen woodland, ponderosa pine/Douglas fir forest, limber pine woodland, and lodgepole pine forest. These grouse prefer to occupy the borders between these habitat types as well as small, interspersed riparian areas for breeding, nesting, and brood rearing (USDI, BLM 1987).

Big Game Species Habitat

Big game species in the RMPPA include pronghorn, deer (mule deer and small numbers of white-tailed deer), elk, moose, black bear, mountain lion (black bear and mountain lion are classified as trophy game animals in Wyoming statutes), and bighorn sheep. These species are either herbivores (pronghorn, deer, elk, moose, bighorn sheep) competing to some degree with other herbivorous wildlife, livestock, and wild horses; carnivores (mountain lion), competing with other wildlife predators; or omnivores (black bear), which have characteristics of both preceding groups.

The populations of the big game species that live in habitat managed by BLM are managed by the WGFD using a complex process that considers both quantitative and qualitative data. Three WGFD regions (Laramie, Green River, and Lander) cover much of the RMPPA. The big game populations evaluated most extensively in all three regions are pronghorn, mule deer, and elk. In the Laramie Region, white-tailed deer, moose, and bighorn sheep populations are also evaluated. Of these, pronghorn, mule deer, and elk are the primary species present on BLM-managed lands within the RMPPA.

Information considered in the WGFD evaluation process includes population indices and harvest statistics for individual herd units. Population indices are such indicators as the number of bucks per 100 does and the number of fawns per 100 does—information that provides perspective on population balance and health. Depending on species, a variety of methods are used to determine herd unit ratio data and data on population trends. Population estimates, considered together with population trend, range condition, weather, management objectives, and the socioeconomic factors of hunter demand and license revenues, are used to develop population objectives for each herd unit. Using WGFD information that was averaged from 1997–2001, comparisons can be made about the species richness and productivity across Wyoming. When numbers for antelope, mule deer, and elk are combined for similar-sized geographic units, the harvest data for the Sierra Madre/Snowy Range area within the RMPPA are similar to those for the Sublette region around Pinedale, which is considered to be the most productive big game region in the state. In addition, recreational days and the economic benefits associated with hunting were 50 percent higher for the Sierra Madre/Snowy Range area when compared with those for the Sublette region.

Pronghorn Habitat

Pronghorn are a unique animal of the western plains and are the only living species in their taxonomic family (*Antilocapridae*). Herds of up to 1,000 individuals once inhabited the plains; now, herds commonly exceed 100 individuals, especially during winter. During winter, herds undertake local

migrations to areas that are more protected from the natural elements or that have more available forage. Pronghorn in the Great Divide Basin are, for the most part, territorial. Pronghorn show strong fidelity to territories and ranges. Any disturbance on summer and transitional ranges influences pronghorn populations through disruption of reproduction (Deblinger and Alldredge 1989). Wyoming is the center of the pronghorn range, and the RMPPA has one of the highest densities of pronghorn in the world (Kotter 2002; Lanka 2002). Pronghorn inhabit a wide variety of open rangeland habitat types throughout the RMPPA and forage primarily on Wyoming big sagebrush and other shrubs.

In most herd units, pronghorn populations are being raised through conservative harvests. Habitat conditions are generally good in terms of supporting pronghorn, and the long-term trend of decreasing domestic sheep numbers has probably benefited pronghorn by reducing competition for forage, particularly on winter ranges. Current management issues affecting pronghorn are varied, but the most important one is livestock fencing that restricts animal movement. Many historic fences were constructed to control domestic sheep and do not meet current fence standards needed to control cattle grazing. During the severe winter of 1983–84, many pronghorn were caught in the corners of these fences and eventually died. Converting these types of fences to current fence standards whenever and wherever possible is a high priority of both BLM and WGFD. Another management issue is maintaining crucial winter range in terms of both health and acreage. During severe winters, animals concentrate on these habitats, and browse use of key species often reaches 100 percent. During more mild winters, pronghorn spend more time on adjacent transition habitat that allows the crucial winter range areas to recover. Development in or loss of this transition habitat is a concern in terms of maintaining pronghorn crucial winter range.

Map 2-53 also shows the 3,860,667 acres of crucial winter range for pronghorn within the RMPPA. This acreage includes federal, private, and state lands. BLM-administered lands include 544,300 acres. These areas are found especially in the open flatlands, in locations like the eastern side of the Great Divide Basin, close along the Wyoming-Colorado state line west of Baggs, the Shirley Basin south to Medicine Bow, and north of Saratoga in the rolling topography east of the North Platte River.

Deer Habitat

Both mule deer and white-tailed deer occur in the RMPPA, although mule deer are by far the more abundant. Mule deer are distributed throughout the seasonal ranges in the RMPPA and generally prefer habitat types in the early stages of plant succession, with numerous shrubs. They use the woody riparian, shrublands, juniper woodland, and aspen woodland habitat types extensively during spring, summer, and fall. These habitat types provide adequate forage areas, with succulent vegetation for lactating females and adequate cover for security and fawning. During winter, mule deer move to lower elevations to avoid deep snow that covers their forage. They are often found in juniper and limber pine woodlands, big sagebrush/rabbitbrush, bitterbrush/sagebrush steppe, and riparian habitat types (USDI, BLM 1987). White-tailed deer use woody riparian habitats (willow, waterbirch, and cottonwood) along the major creeks and rivers for both forage and cover.

Mule deer populations across the RMPPA are being maintained or increased through reduced harvest. Although recent events like the winter conditions of 1992–93 have kept mule deer numbers at lower levels than desired, it is unlikely that the high population of mule deer observed in the 1960s and 1970s will be repeated. Loss of crucial winter range along valley bottoms and movement being restricted by transportation corridors and other fences are limiting factors to growth in mule deer herds. In some locations, such as the Little Snake and North Platte River valleys, conditions of crucial winter range are generally fair to poor. Plant communities are heavily used and shrublands are being taken over by juniper woodlands. Although summer habitats are in better condition, shrublands in many locations are becoming more mature and decadent, with mountain shrubs and aspen converting to predominantly sagebrush. Prescribed burns and other vegetative treatments, both short- and long-term, help to rejuvenate these plant communities, but not enough is occurring. In addition to their habitat, other mule deer management issues

include restrictive fencing (described under “Pronghorn”), increased disturbance and stress due to industrial development and recreational off-road vehicle use, expansion of chronic wasting disease, and housing encroachment into historic habitat, particularly in the Laramie Range and the upper Platte River Valley.

Map 2-54 also shows the 1,468,885 acres of crucial winter range for mule deer within the RMPPA. This acreage includes federal, private, and state lands. BLM-administered lands include 368,700 acres. These areas are generally found in three types of places: on the flanks of mountains (e.g., the Sierra Madre and the Snowy, Laramie, Seminoe, Shirley, and Ferris Mountains), along the drainages (e.g., North Platte and Medicine Bow Rivers), and in the badlands along the Wyoming-Colorado border, centered on Baggs.

Elk Habitat

Elk are distributed throughout the RMPPA, especially adjacent to and in areas of higher elevation that have woody cover. In summer, elk use aspen and conifer woodlands for security and thermal cover, ranging out into upland meadows, sagebrush/mixed-grass, and mountain shrub habitat types to forage. In winter, elk move to lower elevations, foraging especially in sagebrush/mixed-grass, big sagebrush/rabbitbrush, and mountain shrub habitat types, especially in windswept areas where snow depth is less. During severe weather, elk concentrate in crucial winter range—areas within their normal winter range that are most likely to provide thermal cover and forage. For parturition, elk move into areas that provide particularly good security cover and succulent forage. Elk occur in herds to a greater extent than do the other big game mammals. Areas of particular importance to specific elk herds are in the vicinity of Baggs, the Ferris Mountains and Seminoe Reservoir, Shirley Mountain, Encampment, the Saratoga Valley, Laramie Peak, Jelm Mountain, Wick-Beumee, and Pennock Mountain (USDI, BLM 1987). Particularly important characteristics of these areas are as follows:

- **Baggs.** Provides summer, winter/year-long calving and crucial winter range habitat for elk that migrate from summer range in Miller Hill, the Sierra Madre, and the Medicine Bow National Forest on the east and from Colorado on the south to crucial winter range in the vicinity of Baggs. Most of the calving area for this herd is in Medicine Bow National Forest (USDI, BLM 1987). Part of this area is within the Jep Canyon ACEC (USDI, BLM 1990a).
- **Ferris Mountains/Seminoe Reservoir.** Provides summer, winter/year-long, and crucial winter range for elk that migrate from summer range in the Ferris Mountains to crucial winter range on the north side of the mountains, as well as from summer range in the vicinity of Bradley Peak and Seminoe Mountains/Bear Mountain (south of the Ferris Mountains) to crucial winter range southwest of the lower portions of Pathfinder Reservoir. Calving areas have not been identified.
- **Shirley Mountain.** Provides summer, winter/year-long, and crucial winter range for elk that migrate from summer ranges on Shirley Mountain and the Freezeout Mountains to crucial winter range around Chalk Mountain on the south side of the Freezeout Mountains and southeast of the Miracle Mile.
- **Encampment.** Provides winter/year-long and crucial winter range for elk.
- **Saratoga Valley.** Provides calving areas, summer, year-long, and crucial winter range for elk.
- **Laramie Peak.** Provides summer, winter/year-long, and crucial winter range for elk.
- **Jelm Mountain.** Provides primary crucial winter range for elk that summer in Medicine Bow National Forest.
- **Wick-Beumee.** Provides winter/year-long and crucial winter range and parturition habitat for elk on BLM-managed public lands.

- **Pennock Mountain.** Provides winter, winter/year-long, and crucial winter range and parturition habitat for elk on BLM-managed public lands.

In contrast to antelope and mule deer, elk populations have been above desired levels, leading to more liberal harvests to reduce animal numbers. Despite high numbers of elk, habitat conditions are generally good to support existing populations. Since elk spend more of their time at higher elevations where they are not disturbed by human activity, a smaller amount of their habitat has been converted to other uses when compared with that of mule deer or antelope. In addition, because elk diets are similar to cattle diets, efforts to improve range conditions for cattle would also benefit elk. Management issues concerning elk include restrictive fencing, disturbance, and stress from off-road vehicle use; expansion of chronic wasting disease; and housing encroachment into historic habitat, particularly the Laramie Range. Elk populations are also more influenced by movement across the state line with Colorado, making management and population assessments much more difficult than with antelope or mule deer.

The 604,758 acres of crucial winter range and the 200,912 acres of parturition areas shown in Map 2-56 reflect the areas of importance discussed above. This acreage includes federal, private, and state lands. BLM-administered lands include 206,500 acres of elk crucial winter range. North of I-80, winter range is identified on the northeast flanks of the Ferris and Seminoe Mountains; south of I-80, winter range is identified on the west slopes of the Sierra Madre in the North Platte River Valley, between and north of the Sierra Madre and the Snowy Range, on the northeast flanks of the Snowy Range, and east of Laramie on the east side of the Laramie Mountains. Crucial winter range is often an area within the general winter range that has the best thermal cover and most available forage even in the most extreme weather conditions. Areas identified on Map 2-56 are in the Ferris Mountains, the Seminoe Mountains, the Shirley Mountains, and the Snowy Range, in each case on the lower slopes where microclimates provide conditions needed for survival. Parturition areas are similarly in microclimates, where hiding cover and moist, succulent forage provide shelter and adequate moisture for nursing mothers and young elk calves. Such areas are identified in Map 2-56 around the flanks of the Snowy Range and on the east side of the Sierra Madre.

Bighorn Sheep Habitat

Map 2-55 shows crucial winter range and lambing areas for bighorn sheep within the RMPPA. BLM-administered lands include 25,000 acres of crucial winter range.

Because of public interest in them, bighorn sheep are particularly well characterized in the RMPPA. They prefer open grassy ridgetops, slopes, or benches within 100 meters of rocky outcrops, precipitous cliffs, or steep rocky slopes. They most commonly use rockland, upland meadow, sagebrush/mixed-grass, big sagebrush/rabbitbrush, and mountain shrub habitat types, foraging on forbs and grasses from early summer to late fall when they begin browsing on sagebrush, rabbitbrush, and bitterbrush as snows cover their other forage. Management issues concerning bighorn sheep include disturbance, stress from off-road vehicle use, housing encroachment into habitat, and alteration of natural fire cycles. Bighorn sheep have been reintroduced into/augmented in the Ferris Mountains/Seminoe Reservoir area, near Encampment, in the Saratoga Valley, and at Laramie Peak (USDI, BLM 1987). Bighorn sheep are managed cooperatively by BLM for habitat and by WGFD for population.

Other Big Game Species and Trophy Game Animal Habitat

Within the RMPPA there are WGFD management areas for moose (Snowy Range) and trophy game animals including black bear (Laramie Peak, Snowy Range, and Sierra Madre) and mountain lion (Iron Mountain, Laramie Peak, Snowy Range, Seminoe, Sierra Madre, and Haystacks). These represent areas where populations of these species are sufficient to support hunting and to warrant hunting management by WGFD. Data are not readily available to characterize the individual management areas for these

species. These populations are a concern for both agencies: BLM manages habitat and WGFD manages the populations.

Amphibians Habitat

Amphibians are tetrapod, moist-skinned vertebrates, usually without scales. They include frogs, toads, and salamanders. Amphibians live both in water and on land and play important roles in many ecosystems. The larvae of Wyoming species are aquatic. The adults are normally terrestrial, feeding on land, breeding in water, and often escaping into water from their predators. Toads are credited with controlling insect populations. In arid regions, amphibians remain buried in moist soil during daylight hours and emerge to feed at night.

Amphibians represent a food source for many mammals, birds, snakes, and fish. Their principal defense against predators is their ability to move and hide quickly and to produce toxic substances with their skin glands. Breeding calls of male frogs and toads attract mature adults of the same species to suitable breeding sites. Twelve species of amphibians are found in Wyoming: 1 species of salamander and 11 species of frogs and toads.

The tiger salamander is found within the RMPPA and is easily recognized by its conspicuous mottled, barred, or vermiculated color pattern, its moist skin, and the presence of a tail. Tiger salamanders require a fairly moist environment and are found throughout the RMPPA in rodent burrows and lentic habitats during the breeding season and in moist, aquatic, or underground habitats throughout the remainder of the year. Tiger salamanders prey on insects, earthworms, and occasionally small vertebrates.

Toad species located within the RMPPA include the plains spadefoot, Great Basin spadefoot, boreal toad, Wyoming toad, and Woodhouse's toad. Spadefoots are adapted to arid habitats and burrow into soil to prevent desiccation, forage at night, and breed irregularly through the summer in response to periods of heavy rain. The loud call of the breeding male serves to attract other breeding adults, both male and female, to breeding congregations over long distances. Spadefoots spend the winter buried deep within the soil to avoid desiccation and to spend dormancy below the frost line.

Frog species located within the RMPPA include the bullfrog, northern leopard frog, wood frog, and boreal chorus frog. Frogs are slim-waisted, long-legged, smooth-skinned amphibians. True frogs usually have distinctive breeding calls; some also have warning calls and release calls. Eggs are usually laid in large masses that rest on the pond bottom rather than being attached to submerged vegetation (Baxter et al. 1980).

Reptiles Habitat

Reptiles have become adapted to living and reproducing entirely on land. They include turtles, lizards, and snakes. Their skin is dry and normally covered with either horny scales or bony plates to reduce loss of water from the skin and to serve as a protective armor. Their digits are armed with horny claws. The eggs of reptiles are covered by a leathery shell and are normally deposited in soil or sand.

Turtle species located within the RMPPA include the Western painted turtle and common snapping turtle. Turtles are the most primitive of the reptiles, having evolved nearly 200 million years ago. Most turtles are aquatic, although a few live entirely on land. Turtles have unique methods of breathing and a reduced metabolism, which allows certain turtles to pass the period of winter dormancy in pond bottoms.

Lizard species located within the RMPPA include the many-lined skink, northern sagebrush lizard, red-lipped prairie lizard, northern prairie lizard, eastern short-horned lizard, and northern earless lizard. Lizards are small, active reptiles. They are able to regulate their body temperature to permit activity over a broad range of air temperatures. Behavior, agility, and insectivorous habits make the lizard one of the more successful groups of cold-blooded vertebrates. Lizards are found in grasslands and shrub deserts, boulders, cliffs, trees, and loose sand.

Snake species located within the RMPPA include the plains hognose snake, western smooth green snake, pale milk snake, Great Basin gopher snake, bullsnake, wandering garter snake, western plains garter snake, and prairie rattlesnake. Snakes are legless reptiles with a body covering of scales. They are adapted to preying on small rodents and lizards. Snakes are mostly diurnal, terrestrial predators. Some are aquatic, some live in trees, and some live in burrows (Baxter et al. 1980).

Fish Habitat

Fish habitats include perennial and intermittent streams, springs, and flatwater (lakes and reservoirs) that support fish through at least a portion of the year. Condition of the fish habitats is related to hydrologic conditions of the upland and riparian areas associated with or contributing to a specific stream or water body, and to stream channel characteristics. Aquatic habitat quality varies by location and orientation to geographic landforms and vegetation.

Riparian vegetation moderates water temperatures, adds structure to the banks to reduce erosion, provides instream habitat for fish, and provides organic material for aquatic macroinvertebrates. Vegetated flood plains dissipate stream energy, store water for later release, provide areas of infiltration for ground water, support the hyporheic zone of the river, and provide rearing areas for juvenile fish. The quality of the physical aquatic habitat is refined further by water quality. Specifically, water temperature, turbidity, and dissolved oxygen determine the amount of habitat that is usable by different fish species.

Public lands within the RMPPA provide habitat for eight fish families. Wyoming BLM has classified five species as sensitive: the Colorado River cutthroat trout, bluehead sucker, flannelmouth sucker, roundtail chub, and hornyhead chub. In addition, four endangered fish species can be found downstream of the RMPPA within the Colorado River basin (razorback sucker, humpback chub, bonytail chub, and Colorado pikeminnow), and one endangered fish species, pallid sturgeon, can be found downstream of the RMPPA in the Platte River basin.

Three drainages occur within the RMPPA: the Colorado River watershed in the western portion, the North Platte River watershed in the eastern portion, and the Great Divide Basin in the northwest.

Several introduced trout species are widely distributed in the RMPPA, occupying the vast majority of suitable coldwater habitats. For example, brook trout can be found in most mid-high elevation coldwater streams within the RMPPA.

3.19.2 Threatened, Endangered, Candidate, and Proposed Wildlife Species

The species listed below are likely to occur within the RMPPA (Appendix 10). They (1) are federally protected; (2) have associated critical habitat; (3) have been determined to be eligible for listing but are precluded (candidate); (4) are part of a nonessential, experimental population; and/or (5) occur in either the North Platte River or Colorado River system. These species are discussed in further detail in this section.

Section 7 of the ESA requires that federal agencies (such as BLM) address impacts on species listed under the ESA through consultations with USFWS (USDI, BLM 2004b). Consultations begin informally when a federal agency requests a list of species listed under the ESA. If a listed species exists in the area being assessed, informal consultation will continue and/or BLM may prepare a Biological Assessment (BA). The initial determination of effect is made by the lead agency, in this case BLM (50 CFR Part 420). If the BA indicates that the Proposed Action may adversely affect a listed species or its habitat, then BLM must enter formal consultation with USFWS. USFWS then prepares a Biological Opinion (BO) that determines whether the Proposed Plan would adversely affect listed species or critical habitat. The BO is based on information provided in the BA, but the BO may concur with or dispute the determination of

impact. The process of formal and informal consultation with USFWS ensures that BLM actions conserve listed species and their critical habitat.

Bald Eagle (Threatened) Habitat

Bald eagles appear to be recovering rangewide in the lower 48 states; however, they are still listed in the ESA and require special consideration in evaluation of project impacts. In the RMPPA, the bald eagle is generally a winter migrant, but some eagles nest in the RMPPA. Usable nesting habitats do exist in the RMPPA, and, because prey is available, there is the potential for additional nesting bald eagles.

Bald eagles are believed to live for more than 30 years in the wild and even longer in captivity. They mate for life and often reuse old nests from previous years. The eagles' preferred nesting locations are close to rivers, lakes, marshes, and wetland areas. Primary concerns for bald eagles include disease, lack of food, bad weather, and human interference (USDI, BLM 2004b).

Black-Footed Ferret (Endangered) Habitat

Black-footed ferrets are associated with prairie dog communities, which provide potential habitat within the RMPPA. Prairie dog burrows provide potential retreats for ferrets, and the prairie dogs themselves provide a supply of food. Black-footed ferret numbers have been shown to be directly linked to fluctuations in the prairie dog population. In the RMPPA, both the black-tailed prairie dog (*Cynomys ludovicianus*) and the white-tailed prairie dog (*Cynomys leucurus*) are present. Any disturbance to prairie dog towns may affect the black-footed ferret populations. A primary concern, aside from direct loss of the food base, is the potential for distemper transmission from domestic canines to the prairie dogs. A nonessential experimental population of black-footed ferrets has been reintroduced within the RMPPA in the vicinity of the Shirley Basin. Although naturally occurring populations of black-footed ferrets are no longer known within the RMPPA, suitable habitat does exist; therefore, there is always the potential for ferrets to occur (USDI, BLM 2004b).

Canada Lynx (Threatened) Habitat

The Canada lynx is a secretive, forest-dwelling cat that inhabits northern latitudes and high mountains. The lynx feeds primarily on small mammals and birds, particularly snowshoe hares. Habitats utilized by the Canada lynx include old-growth forests. Their home range can be extensive as they forage for food. BLM-administered public lands have limited direct habitat for the lynx; however, they may provide corridors for movement and habitat for forage. There are no identified Lynx Analysis Units (LAU) located on BLM-administered public lands within the RMPPA, but there are LAUs identified on USFS lands adjacent to BLM-administered lands within the RMPPA.

The primary limits to Canada lynx recovery are inadequate habitat areas, fragmentation of habitats, lack of forage, and human intervention (USDI, BLM 2004b).

Platte River System Species (Endangered and Threatened)

The Platte River system species include the least tern, the piping plover, the whooping crane, the Western prairie fringed orchid, and the pallid sturgeon, all of which occur in the Platte River system in association with riverine habitat. The Western prairie fringed orchid is discussed within the vegetation section. Least tern populations are listed as endangered in Nebraska, Colorado, and Montana, but not in Wyoming. The piping plover is listed as threatened, with critical habitat designated in Nebraska and Montana. The pallid sturgeon is listed as an endangered species and is found almost exclusively in the headwaters of the Missouri River (in the vicinity of Fort Benton/Great Falls, Montana) downstream to the Mississippi River near New Orleans, Louisiana. In addition, the pallid sturgeon is found in the Platte River near its confluence with the Missouri River. Although individuals of the four animal species listed above are not likely to be present in any abundance in Wyoming or in the RMPPA, their populations may be susceptible

to actions upstream in the Platte River system. Therefore, any RMPPA actions that may cause water depletion in the Platte River system are carefully considered (USDI, BLM 2004b) (Appendix 11).

Preble's Meadow Jumping Mouse (Threatened) Habitat and Critical Habitat

The Preble's meadow jumping mouse (PMJM) is a small rodent with big feet that are adapted to jumping. It is closely related to other subspecies of meadow mice. The diet of these rodents consists of seeds, fruits, fungi, and insects. Hibernation occurs from October through May in small underground burrows that the mouse excavates. Nests are made of grass, leaves, or woody material excavated several centimeters below ground level. The PMJM is primarily nocturnal or crepuscular but is occasionally observed during the day. Its preferred habitat is low undergrowth consisting of grasses, forbs, or a mixture of both in wet meadows and riparian corridors, or where tall shrubs and low trees provide adequate cover. The PMJM exhibits a preference for lush vegetation along streams and herbaceous understories in wooded areas in close proximity to water. Threats to the PMJM are the loss of riparian habitat, fragmentation of habitat, and reduction in preferred forage.

Although no designated critical habitat for the PMJM is located on BLM-administered lands, the Cottonwood Creek, Chugwater Creek, and Lodgepole Creek and Upper Middle Lodgepole Creek designated critical habitat units do cross the Rawlins RMPPA. The Cottonwood Creek, Chugwater Creek, and Lodgepole Creek and Middle Lodgepole Creek units are collectively composed of 10,542 acres of PMJM habitat extending for a total of 125.1 stream miles on private, state, municipal, or USFS-administered lands.

On February 2, 2005, USFWS proposed to remove the PMJM from the list of threatened species protected by the ESA. The delisting proposal was based on recent genetic research indicating genetic similarities between the PMJM and other subspecies of meadow jumping mouse. In search of the best science available, the USFWS commissioned another scientist to perform genetic analysis of a number of subspecies of meadow jumping mice, and the results of that study seemed to indicate that the PMJM is indeed a distinct subspecies of jumping mouse and should continue to be protected by the ESA. Until a final rule is made, the PMJM will continue to be protected and managed as a "threatened" species under the ESA.

Wyoming Toad (Endangered) Habitat

The Wyoming toad is a federal endangered species whose known natural populations since 1987 have been restricted to a 2-square-mile area around Mortenson Lake, near Laramie and within the RMPPA. An ongoing captive breeding program and reintroductions at selected sites within the toad's historic range in the Laramie Basin are enabling population increases by this species (USDI, BLM 2004b).

Yellow-Billed Cuckoo (Candidate) Habitat

The yellow-billed cuckoo was designated as a candidate for listing by USFWS on July 25, 2001. It utilizes riparian and woodland habitats along rivers and streams in the western United States. The primary forage for the yellow-billed cuckoo is large insects and occasionally small frogs and lizards. The predominant impact on the yellow-billed cuckoo is the loss of large blocks of riparian habitat due to fragmentation, overgrazing, exotic plant community changes, river management, and agricultural conversion of native vegetation. The yellow-billed cuckoo west of the Continental Divide is considered a distinct population segment (USDI, BLM 2004b).

Colorado River System Species

The humpback chub, Colorado pikeminnow, bonytail chub, and razorback sucker are endemic species to the Colorado River drainage. Although these species do not occur within the RMPPA boundary, management actions within the boundary could affect the downstream habitats of these species. These

four Colorado River fish are federally listed as endangered and are directly affected by activities that may deplete water in the Colorado River watershed. USFWS has determined that federal actions resulting in water depletion in the Colorado River system might affect these fish species (USDI, BLM 2004b) (Appendix 11) and would require consultation.

Depletions include evaporative losses and consumptive use of surface or ground water within the affected basin, often characterized as diversions less return flows. Project elements that could be associated with depletions include but are not limited to ponds (detention, recreation, irrigation storage, and stock watering), lakes (recreation, irrigation storage, municipal storage, and power generation), pipelines, wells, diversion structures, and water treatment facilities.

A recovery plan and the resulting Recovery Implementation Program for the four Colorado River fish have been approved. The recovery plan includes life history descriptions, distribution, reason for decline, current conservation efforts, and recovery strategy for the species. The Recovery Implementation Program includes the actions that must be taken to remove the species from federal listing (USDI, BLM 2004b).

Threatened, Endangered, Candidate, and Proposed Plant Species

Threatened, endangered, candidate, and proposed plants that are located within the RMPPA are discussed in further detail in 3.15.6.

3.19.3 BLM Wyoming State Director's Sensitive Species List Habitat Management

BLM and WGFD are responsible for managing a wide array of wildlife and associated habitat in the RMPPA. In general, WGFD is responsible for managing the wildlife populations and BLM manages the habitats on public lands. Wildlife species listed on the BLM Wyoming State Director's Sensitive Species List and their associated habitats are discussed in this section. These animals are recognized as being of particular interest to the public and are a focus for management. BLM Sensitive Plant Species are discussed in further detail in 3.15.7.

- Currently, 18 mammal, bird, amphibian, fish, and plant species in the RMPPA are federally listed or are candidates and must be taken into consideration for management activities (Appendix 10). BLM has also identified an additional 9 state sensitive mammal species, 15 bird species, 3 amphibian species, 5 fish species, and 8 plants.

Information is provided below on the habitats, regulatory and consultation requirements, and species of concern relevant to the RMPPA planning process.

Habitats Supporting Species of Special Concern

The RMPPA includes a diversity of habitats on which BLM generally focuses most management efforts. These habitats are the major plant communities or terrestrial features within the review area that are important to wildlife. Wildlife habitats include streamside riparian, springs, seeps, wet meadows, seasonal wetlands, playas and lakebeds, cliffs, caves, talus slopes, dry meadows, dryland shrubs, juniper woodlands, ponderosa pine forests, mixed conifer forests, and quaking aspen groves.

In these important vegetation communities, ongoing changes, many of them caused by humans, have altered the animal habitat within the RMPPA. Examples of management practices that have modified these habitats include the conversion of wet meadows to dry meadows due to lowering of water tables, conversion of shrublands to juniper woodlands primarily due to changes in fire regimes, and the conversion of aspen groves to shrubland due to fire suppression and grazing. These practices have reduced the size and number of these limited habitats important to species of special concern. BLM

manages these habits for species that are threatened or endangered, or are candidates for or proposed for listing under federal and state mandates. BLM also manages habitat for species on the Wyoming BLM Sensitive Species List under BLM mandate to avoid further decline of these species.

Mountain Plover Habitat

The mountain plover breeds and nests in the RMPPA, typically utilizing habitats characterized as mixed-grass and shortgrass prairie, cushion plant communities, shrub-steppe, plains, alkali flats, agricultural lands, and prairie dog towns. Approximately 50 percent of the RMPPA is potential mountain plover habitat: mountain plover surveys have identified large areas of occupied habitat where mountain plovers breed and nest. Plovers may nest on sites where vegetation is sparse or absent, or near closely cropped areas. Mountain plovers are rarely found near water and show a preference for previously disturbed or modified habitats. The primary forage for the mountain plover is insects, grass seeds, and berries. Within the RMPPA, the nesting period appears to be the most critical time for the mountain plover. Predation, disturbance, abandonment of the nest, and direct destruction of the nest are potential impacts.

White-Tailed Prairie Dog Habitat

White-tailed prairie dogs inhabit open or slightly brushy country, including habitat with scattered junipers and pines, and are located throughout the RMPPA. These species are similar to the black-tailed prairie dog but are less colonial. These species do hibernate from October or November to March. The white-tailed prairie dog has a yellowish body, but the tip of the tail is white (Burt et al. 1980).

Black-Tailed Prairie Dog Habitat

Black-tailed prairie dogs inhabit dry upland prairies and are located in the northeast corner of the RMPPA. These animals are diurnal and live in towns. Within towns, small groups of black-tailed prairie dogs will display territorial behavior toward adjacent groups. They feed mostly on forbs and grasses but may eat grasshoppers and other insects. They live in burrows with mounds that are usually 1 to 2 feet high and 25 to 75 feet apart from each other. Black-tailed prairie dogs may be dormant for short periods of time in cold weather but are not true hibernators. They do compete with livestock for food; however, the amount is negligible. Although once numerous on the prairies, they are now reduced to a few towns through poisoning operations. The black-tailed prairie dog has a yellowish body, but the tip of the tail is black (Burt et al. 1980) (USDI, BLM 2004b).

Greater Sage-Grouse Habitat

Map 3-13 shows the general locations of greater sage-grouse (*Centrocercus spp.*) leks, or strutting grounds, and adjacent nesting areas within the RMPPA. During spring, grouse concentrate for courtship and breeding in these areas, which are typically in openings surrounded by sagebrush, with an average canopy density of 10 to 30 percent. Greater sage-grouse nest under sagebrush, with 60 percent of hens nesting within a 2-mile radius of the lek, and 70 percent of hens nesting within a 4-mile radius of the lek. Young birds rely initially on insects. During warm, dry summer periods, grouse tend to stay within 1.5 miles of intermittent and perennial streams, where they feed on succulent forbs. Greater sage-grouse diets shift to a majority of sagebrush later in the year. Wintering areas for greater sage-grouse typically contain tall sagebrush that is available above the snow for cover and food (USDI, BLM 1987). Total shrub canopy cover, residual grass cover, nonfood forb cover, and litter cover are the best predictors of greater sage-grouse nesting habitat (Holloran 1999; Lyon 2000). Typically, greater sage-grouse nests are located within sagebrush communities that have 10 to 30 percent canopy cover (Holloran 1999; Lyon 2000). The chance of a sage-grouse nest successfully hatching will increase 30 percent if it is in combination with herbaceous vegetation exhibiting 20 percent cover and equal to or greater than 15 centimeters in height (Holloran 1999). Nest success ranges from 12 to 86 percent, which is relatively low compared with other

prairie grouse species (Connelly et al. 2000). Maintaining continuous tracts of suitable habitat and a suitable distance from disturbance are critical to the success of greater sage-grouse.

Greater 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 percent from 1985 to 1995. Conservative estimates suggest that 50 percent of the original area occupied by sage-grouse is no longer capable of supporting the species on an annual basis (Connelly and Braun 1997). Wyoming historically supports more greater sage-grouse than any other state because of the prevalence of sagebrush habitats (Patterson 1952). The areas in central and western Wyoming where sagebrush dominates landscapes and grouse populations remain relatively contiguous and intact cumulatively represent one of the species' last strongholds. The number of male sage-grouse counted per lek in Wyoming decreased 17 percent between 1985 and 1995 (Connelly and Braun 1997), and regional declines as high as 73 percent 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 where the birds typically reside are thought to be among the principal factors.

Existing RMPPA-wide and statewide guidance prohibits exploration and development activity within 1/4 mile of a lek. There is also a timing stipulation within 2 miles of the lek center that protects breeding and nesting greater sage-grouse, as well as a timing stipulation on winter habitat that protects wintering greater sage-grouse. It should be noted that approximately 40 percent of the nesting birds would not be protected by current timing stipulations (Holloran and Anderson 2005). Efforts are being made to map suitable nesting habitat, which may extend beyond the current 2-mile buffer. This effort will provide protection for a greater percentage of the suitable nesting habitat and nesting sage-grouse while allowing development to occur. When sagebrush habitats are degraded by such things 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 or, in some cases, 30 years. Wyoming big sagebrush may require 30 to 40 years to recover. Basin big sagebrush has intermediate recovery rates between these two species (Slater 2003).

If 40 percent of nesting, early brood-rearing, or winter habitat has been lost or severely degraded within the range of a population, the management emphasis is to protect remaining sagebrush that is at least somewhat suitable for these functions (Connelly et al. 2000). Within comparatively intact sagebrush ecosystems, treating up to 20 percent of degraded nesting and early brood-rearing habitats and 30 percent of the winter habitat may be acceptable to improve habitat conditions (e.g., restoring herbaceous understory; creating open patches of herbaceous vegetation; creating thin dense sagebrush canopies exceeding 30 percent cover; creating openings within dense sagebrush; regenerating the shrub component by setting back succession; enhancing herbaceous understory by reducing herbivory). At some point it becomes difficult to mitigate habitat loss by treating vegetation, because the interim loss of habitat to the treatment, combined with the habitat loss that is being mitigated, creates an unacceptable level of impact to greater sage-grouse (Connelly et al. 2000). These impacts are related not only to loss of nesting and roosting habitat but also decreased food availability. Brood movement decreases with optimal food availability, resulting in lower predator exposure and energetic costs of foraging (Lyon 2000). When availability of forbs and grass is lowered, broods move longer distances and expend more energy to find forage. The increase of movement, in addition to decreased grass for screening, may cause chicks to be more exposed to predation (Lyon 2000).

In addition to habitat loss, development adjacent to sage-grouse lek sites may attribute to declines in yearling male recruitment. Braun (1986) hypothesized that adult male greater sage-grouse return to leks where they have established a territory until they die. Mining activity and large-scale habitat loss adjacent to these leks reduce the number of yearling males recruited to replace the adults. Increased road construction associated with such development may also impact greater sage-grouse populations. Construction of these roads results in permanent travel routes; improved public access; increased long-term, traffic-related disturbance to previously inaccessible regions; indirect noise impacts to leks from the

road; and direct mortality (Braun 1998). Roads also provide a clear pathway for predator movement unimpeded by vegetation or other obstructions (Lyon 2000). The road effect-distance, or the distance from a road at which a population density decrease is detected, is positively correlated with increased traffic density and speed and is more critical in years when wildlife populations are low (Forman and Alexander 1998). Studies conducted in Montana, Wyoming, and Colorado suggest that some recovery of sage-grouse populations may occur after a site has been initially developed (with subsequent reclamation of energy development, roads, etc.) (Braun 1997). However, there has been no evidence that population levels attain their size before the disturbance.

Female sage-grouse also demonstrate site fidelity in relation to nesting areas surrounding the lek (Lyon 2000; Schroeder et al. 1999). In addition, female yearlings nest in the same areas as their mothers (Lyon 2000). Even in areas of high disturbance, females continue to maintain their site fidelity; however, this is not without some behavioral modification. The results from a study conducted by Lyon (2000) indicated that hens captured on disturbed leks demonstrated lower nest initiation rates, traveled twice as far to nest sites, and selected higher total shrub canopy cover and live sagebrush canopy cover than hens captured off of undisturbed leks.

Columbian Sharp-tailed Grouse Habitat

Historically in Wyoming, the range of the Columbian sharp-tailed grouse extended westward from the Continental Divide. Currently, the only Wyoming population of Columbian sharp-tailed grouse is found within the RMPPA, located from the Colorado state line north to the Sand Hills ACEC. These grouse typically are found in mountain and basin big sagebrush habitat. In spring this species concentrates on traditional dancing grounds for courtship and breeding. These dancing grounds are typically found in mixed-shrub habitat of antelope bitterbrush, snowberry, serviceberry, chokecherry, and big sagebrush, evenly mixed with grasses and forbs. Broods in Wyoming are found most often in mountain shrub and sagebrush, with a high density of snowberry. Birds move to ridges and knolls in mountain shrub habitat during the fall, and then move to riparian habitat with exposed mixed-shrub communities at all elevations in the winter, where they feed on buds, berries, and catkins (USDI, BLM 1987). There is currently no hunting season for Columbian sharp-tailed grouse, but there are some accidental takings where the populations overlap with greater sage-grouse. The bird was proposed for listing, but this was found not warranted by USFWS.

Western Boreal Toad Habitat

The Southern Rocky Mountain population of the boreal toad (*Bufo boreas*) has suffered drastic population reductions since the early 1980s in the Southern Rockies and declines in the Sierra Madre. The western boreal toad is currently a candidate species for listing under the Endangered Species Act of 1973, as amended. Causes for decline are being investigated and include impacts from the occurrence of the chytrid fungus (*Batrachochytrium dendrobatidis*). Habitats used by this species include wet meadows and marshes, encompassing riparian areas and pond margins. A Conservation Plan and Agreement for the management and recovery of the Southern Rocky Mountain population of the boreal toad was completed in February 2001 (USDI, BLM 2004b).

Other BLM Wyoming State Director's Sensitive Species Habitat

In addition to the BLM Wyoming State Director's Sensitive Species discussed in detail above, there are eight mammals, four raptors, eight neotropical migratory birds, two amphibians, and four fish species that are also included on this list and are identified below. The BLM Wyoming State Director's Sensitive Plant Species that are located within the RMPPA are discussed in further detail in 3.15.7.

Mammals

The sensitive mammals include three bat species, one shrew species, one gopher species, and one fox species, which are listed below. The habitats required to support the life functions of the species are also listed below:

- **Wyoming Pocket Gopher.** Meadows with loose soil
- **Swift Fox.** Grasslands and greasewood-dominated flats
- **Long-Eared Myotis.** Caves, rocky outcrops, and abandoned mines
- **Fringed Myotis.** Caves and abandoned mines
- **Townsend's Big-Eared Bat.** Caves, rocky outcrops, and abandoned mines
- **Spotted Bat.** Cliffs over perennial water and basin-prairie shrub
- **Pygmy Rabbit.** Basin-prairie and riparian shrub.

Birds

The Migratory Bird Treaty Act of 1918 protects waterfowl, eagles, raptors, and other avian species that migrate through the RMPPA. Specific concerns include harassment, collection, molestation, disturbance, and killing. Impacts to nesting migratory birds, including collection of eggs, nests, or birds, and harassment of nesting birds are considered activities that violate the Migratory Bird Treaty Act.

There is a diversity of neotropical migratory bird species located throughout the RMPPA area that require specific habitat types for their life cycles. These species can be either generalists or specialists and occupy one or more of the following habitat types: forest and woodland communities, grasslands, shrub communities, and wetland/riparian communities including desert riparian, foothills, and mountain riparian communities (Section 3.15, Vegetation). These species occupy diverse niches and may require additional management.

Raptors

BLM Sensitive raptors include species that feed on rodents and avifauna found in the RMPPA. These are as follows:

- **Ferruginous Hawk.** Basin-prairie shrub, grasslands, and outcroppings
- **Peregrine Falcon.** Tall cliffs
- **Burrowing Owl.** Grasslands, basin-prairie shrub, and prairie dog towns
- **Northern Goshawk.** Conifers and deciduous forests.

Neotropical Migratory Birds

BLM Sensitive neotropical migratory birds found in the RMPPA include the following:

- **Loggerhead Shrike.** Basin-prairie and mountain foothill shrub
- **White-Faced Ibis.** Marshes and wet meadows (shorebird)
- **Trumpeter Swan.** Lakes, ponds, and rivers (migratory)
- **Long-Billed Curlew.** Grasslands, plains, and wet meadows
- **Brewer's Sparrow.** Basin-prairie shrub
- **Sage Thrasher.** Basin-prairie and mountain foothill shrub
- **Sage Sparrow.** Basin-prairie and mountain foothill shrub
- **Baird's Sparrow.** Grasslands and weedy fields.

Amphibians

The northern leopard frog and the Great Basin spadefoot toad have been identified as sensitive species by BLM. They occur in marshes and wetlands in the project area. There is a regionwide decline in these species, resulting in initiation of several amphibian recovery efforts by federal and state entities.

Reptiles

At this time there are no sensitive species reptiles identified on the BLM Wyoming State Director's Sensitive Species List for the RMPPA.

Fish

Of the native fishes found within the RMPPA, five species have been identified as Sensitive Species by Wyoming BLM. These include the Colorado River cutthroat trout, roundtail chub, bluehead sucker, flannelmouth sucker, and hornyhead chub. In response to observed declines in the distribution of these species, conservation strategies have been developed or initiated in cooperation with state natural resource management agencies and federal agencies for all species with the exception of the hornyhead chub. Currently, a conservation plan and management strategy has not been implemented for the hornyhead chub. However, federal authorized actions would consider hornyhead chub habitat as part of the BLM Manual 6840—Special Status Species Policy.

Factors that have been identified as contributing to the observed reduction in the range of Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) include the effects of introduced fish and land management practices that alter the suitability of coldwater stream habitat. Management of Colorado River cutthroat trout populations within the RMPPA is guided by two efforts: the Conservation Agreement and Strategy for Colorado River Cutthroat Trout in the states of Colorado, Utah, and Wyoming provides rangewide guidance, and the Conservation Plan for Colorado River Cutthroat Trout—Little Snake River, Southeastern Wyoming, details actions to be taken locally to ensure the persistence of this species in the Little Snake River enclave. This local plan identifies areas where the management of this species will be emphasized. Within the RMPPA, the area of emphasis is the upper Muddy Creek watershed. Within the upper Muddy Creek watershed, the plan identifies actions that will need to be taken to restore the native fish community to the stream (now occupied by introduced fish). These actions include the removal of introduced fish, reintroduction of native fish, and management of fish habitats. These actions will result in the temporary loss of angling opportunities while the introduced fish are removed and subsequently replaced with native fishes.

As a signatory to the local management plan for Colorado River cutthroat trout, the RMPPA has significant responsibilities for the management of habitats within the upper Muddy Creek drainage to increase the suitability of the systems for reintroduction of Colorado River cutthroat trout and to increase the stability of riparian systems. As actions are taken to reach this goal, the number of stream miles available to coldwater fish such as trout will increase. It is anticipated that the number of stream miles available to trout species will roughly double as a result of implementing these conservation strategies, providing increased angling opportunities and helping to ensure the persistence of this native fish. Increased riparian functionality and stability would further increase the suitability of riparian habitats for a number of terrestrial and aquatic wildlife species, such as big game species and amphibians.

Additional conservation planning efforts have been initiated for roundtail chub, bluehead sucker, and flannelmouth sucker throughout their range as a result of observed declines in the distribution of these species. These declines have been attributed to a combination of factors, including the effects of introduced fish, water development activities, and land management activities. Current conservation planning efforts emphasize the need to better understand populations of these native fish and factors affecting their viability in order to identify biologically meaningful conservation actions. As a result of these needs, the RFO, in cooperation with the University of Wyoming and WGFD, has actively

conducted research on the habitat associations, movements, and fish community associations of these three species within the Muddy Creek watershed. The fish community of the Muddy Creek watershed is unique to Wyoming, harboring populations of each of these three native fishes. The presence of these species presents a unique opportunity for BLM as well as its cooperators to proactively contribute to the understanding of the habitat requirements and the life history characteristics of these species. These efforts will be used to help develop effective and biologically meaningful conservation strategies that preclude the need to list these species as threatened or endangered under the ESA.

