Chapter 3. Affected Environment

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This chapter describes existing conditions for the resources in the Buffalo Field Office planning area and serves as the baseline against which Chapter 4 analyzes and compares impacts under alternatives A, B, C, and D. A variety of laws, regulations, policies, and other requirements direct public land management, as summarized in Chapter 1. The Buffalo Field Office operates under these requirements and guidance. In addition to describing existing conditions, this chapter describes management challenges as identified through the Bureau of Land Management (BLM) Analysis of the Management Situation (AMS) and issues identified during the public scoping process.

3.1. Physical Resources

3.1.1. Air Quality

This section describes the air resources in the region that would be potentially affected by BLM activities and decisions in the Buffalo planning area. The discussion of air resources includes a description of the topography, climate, climate change, and existing air quality of the planning area. Air pollutants addressed include criteria air pollutants, hazardous air pollutants (HAPs), and sulfur and nitrogen compounds that could contribute to Air Quality Related Values (AQRV), including visibility, atmospheric deposition, and acid rain.

3.1.1.1. Regional Context

For this analysis, air quality data were examined from monitors located within the planning area (Campbell, Johnson, and Sheridan counties) and in nearby areas (Weston and Converse counties). Air quality data from these locations provides an overall summary of current air quality conditions within the planning area and in the surrounding regions.

3.1.1.2. Regulatory and Policy Framework

The Clean Air Act (CAA) and its amendments mandate the control of air pollutants throughout the United States. The CAA imposes an obligation on all state and federal agencies, including the BLM, to comply with all state and local air pollution requirements. The CAA addresses criteria air pollutants, state and National Ambient Air Quality Standards (NAAQS) for criteria air pollutants, AQRVs such as visibility and deposition, and the Prevention of Significant Deterioration (PSD) program.

Further, the National Environmental Policy Act ([NEPA] Public Law 91-190, January 1, 1970) requires federal agencies to "… promote efforts which will prevent or eliminate damage to the environment …" and to "… attain the widest range of beneficial uses … without degradation, risk to health and safety, or other undesirable and unintended consequences …"

Air quality protection is also a part of the Federal Land Policy and Management Act ([FLPMA] Public Law 94-579, October 21, 1976), which states that "… it is the policy of the United States that … the public lands be managed in a manner that will protect … air and atmospheric … values …"

3.1.1.3. Indicators

This analysis addresses criteria pollutants (carbon monoxide [CO], nitrogen oxide [NO_x], particulate matter less than 2.5 microns in diameter [$PM_{2.5}$, particulate matter less than 10 microns in diameter [PM_{10}], sulfur dioxide [SO_2], organics and toxics (HAPs and volatile organic compounds [VOCs]), and sulfur and nitrogen compounds, which could contribute to visibility impairment and atmospheric deposition, including acid rain. The analysis also addresses greenhouse gases (GHG) including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The NAAQS set the maximum standards for criteria air pollutants. The CAA provides special protection for air quality and visibility in designated classified areas of the country. National parks larger than 6,000 acres and wilderness areas larger than 5,000 acres that existed or were authorized as of August 7, 1977 receive the highest degree of air quality protection under the CAA. The CAA originally designated the 158 Class I areas, but in 1980 Bradwell Bay, Florida, and Rainbow Lake, Wisconsin were excluded for purposes of visibility protection. In addition to the 156 remaining Class I areas, five Tribal areas have been designated Class I areas, including the Northern Cheyenne area, which is located in Montana just north of the Buffalo planning area. All other wilderness areas (and areas such as national monuments and seashores) are designated Class II. For air quality impact analyses as part of EIS development, the Class II wilderness area may be referred to as a sensitive Class II wilderness area because potential air pollutants could impair air quality concentrations, visibility, or lake acidification in these areas. The CAA's Prevention of Significant Deterioration (PSD) program establishes allowable increases of a given pollutant for a particular area from specific sources. For the purposes of the RMP, no formal PSD increment consumption analysis will be performed since this is handled through the permit process for a particular new source by state or other Federal agencies.

Criteria Air Pollutants

The U.S. Environmental Protection Agency (EPA) has established air quality standards for criteria pollutants and identifies them as the NAAQS. Concentrations of air pollutants greater than the national standards represent a risk to human health. Criteria pollutants include CO, nitrogen dioxide (NO_2), ozone (O_3), PM_{10} and $PM_{2.5}$, sulfur dioxide (SO_2), and lead.

Wyoming and National Ambient Air Quality Standards

Wyoming Ambient Air Quality Standards (WAAQS) and NAAQS identify maximum limits for criteria air pollutant concentrations at all locations to which the public has access. The WAAQS and NAAQS are legally enforceable standards. Concentrations above the WAAQS and NAAQS represent a risk to human health that by law, require public safeguards be implemented. State standards must be at least as protective of human health as federal standards, and may be more restrictive than the federal standards.

Volatile Organic Compounds and Hazardous Air Pollutants

There are numerous organic compounds in the atmosphere, referred to as VOC, that are emitted from anthropogenic sources, such as petroleum products, paints, stains, etc., and from biogenic sources, such as trees and crops, that act as precursors to O_3 production and secondary aerosol formation. Because of their toxic effects, a subset of these compounds have been designated as HAPs, including benzene, toluene, ethylbenzene, xylene (also referred to as BETEX), N-hexane, and formaldehyde. Although HAPs do not have federal ambient air quality standards (there are exposure thresholds), some states have established "significance thresholds" to evaluate human exposure for potential chronic inhalation illness and cancer risks. The State of Wyoming has not established any ambient air quality standards or significance thresholds for HAPs.

Visibility

Visibility can be expressed in terms of deciviews, a measure for describing perceived changes in visibility. One deciview is defined as a change in visibility that is just perceptible to an average person, which is approximately a 10% change in light extinction. To estimate potential visibility impairment, monitored aerosol concentrations are used to reconstruct visibility conditions for each day monitored. These daily values are then ranked from clearest to haziest and divided into three categories to indicate the mean visibility for all days (average), the 20% of days with the clearest visibility (20% clearest), and the 20% of days with the worst visibility (20% haziest). Visibility can also be defined by standard visual range (SVR) measured in miles, and is the farthest distance at which an observer can see a black object viewed against the sky above the horizon; the larger the SVR, the cleaner the air.

Since 1980 the Interagency Monitoring of Protected Visual Environments (IMPROVE) network has measured visibility in national parks and wilderness areas. There are six IMPROVE stations in Wyoming, including two in the Buffalo planning area — one in the Thunder Basin National Grasslands and one in the Cloud Peak Wilderness.

Atmospheric Deposition

Atmospheric deposition refers to processes by which air pollutants are removed from the atmosphere and deposited into terrestrial and aquatic ecosystems. Air pollutants can be deposited by either wet (precipitation via rain or snow) or dry (gravitational) settling of particles and adherence of gaseous pollutants to soil, water, and vegetation. Much of the concern about deposition is due to secondary formation of acids and other compounds from emitted nitrogen and sulfur species such as NO_x and SO_2, which can contribute to acidification of lakes, streams, and soils, and affect other ecosystem characteristics, including nutrient cycling and biological diversity.

Substances deposited include:

- Acids, such as sulfuric and nitric, sometimes referred to as acid rain
- Air toxics, such as pesticides, herbicides, and VOCs
- Heavy metals, such as mercury
- Nutrients, such as nitrates and ammonium

The accurate measurement of atmospheric deposition is complicated by contributions to deposition from several components – rain, snow, cloud water, particle settling, and gaseous pollutants. Deposition varies with precipitation and other meteorological variables (e.g., temperature, humidity, winds, and atmospheric stability), which in turn, vary with elevation and time.

Monitoring of Air Quality, Visibility, and Deposition in the Buffalo Planning Area

Various state and federal agencies continuously monitor air pollutant concentrations, visibility, and atmospheric deposition in and near the Buffalo planning area. Table 3.1, "Air Quality Monitoring Sites in and Near the Buffalo Planning Area" (p. 190) lists the air quality monitoring sites in the Buffalo planning area (Sheridan, Johnson, and Campbell counties), as well as sites in adjacent counties (Weston and Converse counties). The Wyoming Department of Environmental

Quality (DEQ) operates monitors as part of the State and Local Monitoring Site (SLAMS) network and the Special Purpose Monitoring (SPM) network.

There are two monitors in the IMPROVE network located in the Buffalo planning area – one in the Cloud Peak Wilderness in Johnson County and one in the Thunder Basin National Grasslands in Campbell County. The BLM operates monitors in Johnson County as part of the Wyoming Air Resource Monitoring System (WARMS), including one at the Buffalo site. The Clean Air Status & Trends Network (CASTNet) measures concentrations of nitrogen and sulfur compounds and ozone at three sites in Wyoming, including Medicine Bow National Forest in southeast Wyoming near Centennial, Pinedale, and Yellowstone National Park. Because none of the CASTNet sites are near the Buffalo planning area, data from these sites might not be representative of concentrations in the Buffalo planning area. Atmospheric deposition (wet) measurements of ammonium, sulfate, and various metals are taken at the Newcastle monitor, which the BLM operates as part of the National Acid Deposition Program (NADP).

Table 3.1. Air Quality Monitoring Sites in and Near the Buffalo Planning Area

County	Site Name	Type of Monitor	Parameter	Operating Schedule	Location	
					Longitude	Latitude
Air Quality Monitoring Sites in the Planning Area						
Campbell	Thunder Basin	SPM	O_3, NO_x, and meteorology	Hourly	-105.3000	44.6720
	South Campbell County	SPM	O_3, NO_x, PM_{10}, and meteorology	1/3 (PM_{10}) and hourly (NO_x and O_3)	-105.5000	44.1470
	Belle Ayr Mine	SPM	NO_x and $PM_{2.5}$	1/3 ($PM_{2.5}$) and hourly (NO_x)	-105.3000	44.0990
	Wright	SPM	PM_{10}	1/6	-105.5000	43.7580
	Gillette	SLAMS	PM_{10}	1/6	-105.5000	44.2880
	Black Thunder Mine	SPM	$PM_{2.5}$	1/3	-105.2000	43.6770
	Buckskin Mine	SPM	$PM_{2.5}$	1/3	-105.6000	44.4720
	South Coal	WARMS	$PM_{2.5}$ and meteorology		-105.8378	44.9411
	Thunder Basin	IMPROVE	$PM_{2.5}$, nitrates, ammonium, nitric acid, sulfates, SO_2, and meteorology	1/3	-105.2874	44.6634
Johnson	Buffalo	WARMS	$PM_{2.5}$, nitrate, ammonium, nitric acid, sulfate, SO_2, and meteorology	1/3 ($PM_{2.5}$) & Weekly (others)	-106.0189	44.1442
	Cloud Peak	IMPROVE	$PM_{2.5}$, nitrate, ammonium, nitric acid, sulfate, SO_2, and meteorology	1/3	-106.9565	44.3335

County	Site Name	Type of Monitor	Parameter	Operating Schedule	Location	
					Longitude	Latitude
Sheridan	Sheridan - Highland Park	SLAMS	PM_{10} and $PM_{2.5}$	1/3 (PM_{10}); 1/3 and 1/6 ($PM_{2.5}$)	-107.0000	44.8060
	Sheridan - Police Station	SLAMS	PM_{10} and $PM_{2.5}$	1/1 (PM_{10}); 1/3 and 1/6 ($PM_{2.5}$)	-107.0000	44.8330
	Arvada	SPM	PM_{10}		-106.1000	44.6540
	Sheridan	WARMS	$PM_{2.5}$, nitrate, ammonium, nitric acid, sulfate, and SO_2	1/3 ($PM_{2.5}$) & 1/7 (others)	-106.8472	44.9336
Air Quality Monitoring Sites near the Planning Area						
Weston	Newcastle[1]	WARMS	$PM_{2.5}$, nitrate, ammonium, nitric acid, sulfate, SO_2, and meteorology	1/3 ($PM_{2.5}$) and 1/7 (others)	-104.1919	43.8731
	Newcastle	NADP	Wet deposition of ammonium, sulfates, and metals	Weekly	-104.1917	43.873
Converse	Antelope Mine	SPM	NO_x and $PM_{2.5}$	1/3 ($PM_{2.5}$) & hourly (NO_x)	-105.4000	43.42700
	Basin[1]	CASTNET	O_3, $PM_{2.5}$, nitrate, ammonium, nitric acid, sulfate, and meteorology	Hourly (O_3, $PM_{2.5}$) Weekly all others	-108.0411	44.28

Source: WARMS 2013; EPA 2009; IMPROVE 2009; Wyoming DEQ 2009b; Wyoming DEQ 2009a; National Atmospheric Deposition Program 2009

[1]Newcastle and Basin WARMS sites were upgraded to full CASTNET sites in 2012

1/3 Sampling occurs once every 3 days
1/6 Sampling occurs once every six days
CASTNET Clean Air Status and Trends Network
IMPROVE Interagency Monitoring of Protected Visual Environments
NADP National Atmospheric Deposition Program
SLAMS State and Local Monitoring Site
SPM Special Purpose Monitoring
WARMS Wyoming Air Resource Monitoring System
NO_x nitrogen oxides
O_3 ozone
PM_{10} particulate matter with an aerodynamic diameter equal to or less than a nominal 10 microns
$PM_{2.5}$ particulate matter with an aerodynamic diameter equal to or less than a nominal 2.5 microns
SO_2 sulfur dioxide

3.1.1.4. Current Condition

Climate

The climate in the planning area is temperate; it is a semi-arid region with long cold winters and short summers. The major factors controlling climate in the planning area are elevation, strong westerly winds, moisture flow, and mountainous barriers to the west. Elevations in the planning area are both variable and relatively flat, ranging from 3,400 feet along the Powder River at the Montana state line to 6,000 feet at the top of the Pumpkin Buttes; the elevation is 4,544 feet near Gillette and 4,645 feet near Buffalo. The Big Horn Mountains along the western edge of the planning area rise to more than 13,000 feet. In Gillette, monthly average temperatures range from 21.6 degrees Fahrenheit (°F) in the winter to 70.8°F in the summer. Wind speed and direction are highly variable because of the effect of local topography in the planning area. Wind speeds are generally strong and gusts above 40 miles per hour are not unusual. Table 3.2, "Climate Information for the Buffalo Planning Area" (p. 192) lists temperature, precipitation, and wind speed data for the planning area.

Table 3.2. Climate Information for the Buffalo Planning Area

Climate Component	Description
Temperature	Mean maximum summer temperature[1]: 81.6 °F and 82.4 °F Mean minimum winter temperature[1]: 11.8 °F and 13.5 °F Mean annual temperature[1]: 45.6 °F and 45.2 °F
Precipitation	Mean annual precipitation: 13 to 17 inches Mean annual snowfall: 33 and 67 inches
Winds	Mean annual wind speed: 9.3 miles per hour Prevailing wind direction: north/northwest
Source: Western Regional Climate Center 2009 [1]Buffalo (site 481165) and Gillette (site 483855) respectively °F degrees Fahrenheit	

Air Quality

Table 3.3, "Applicable National and State Primary Air Quality Standards for Criteria Pollutants and Recent Representative Concentrations for the Planning Area" (p. 192) is an overview of the applicable primary WAAQS and NAAQS and recent representative pollutant concentrations measured in or near the planning area. Figure 3.1, "Representative Maximum Pollutant Concentrations in the Buffalo Planning Area as a Percentage of the NAAQS" (p. 193) shows that the planning area is currently in compliance with all applicable national air quality standards.

Table 3.3. Applicable National and State Primary Air Quality Standards for Criteria Pollutants and Recent Representative Concentrations for the Planning Area

Pollutant	Averaging Time	NAAQS			WAAQS			Representative Concentrations		
		(ppm)	(ppb)	(µg/m^3)	(ppm)	(ppb)	(µg/m^3)	(ppm)	(ppb)	(µg/m^3)
Carbon Monoxide	1 hour[1]	35	35,000	40,000	35	35,000	40,000	0.77	800	920
	8 hour[1]	9	9,000	10,000	9	9,000	10,000	0.5	500	575
Nitrogen Dioxide	1 hour[2]	0.10	100	188	0.10	100	188	0.011	11	21
	Annual[3] (Arithmetic Mean)	0.053	53	100	0.053	53	100	0.002	2.0	4
Ozone	8 hour[4]	0.075	75	147	0.075	75	147	0.062	62	122
PM_{10}	24 hour[5]	N/A	N/A	150	N/A	N/A	150	N/A	N/A	41
	Annual[6]	N/A	N/A	N/A	N/A	N/A	50	N/A	N/A	11
$PM_{2.5}$	24 hour[7]	N/A	N/A	35	N/A	N/A	35	N/A	N/A	13
	Annual[8]	N/A	N/A	12	N/A	N/A	15	N/A	N/A	5.3

Pollutant	Averaging Time	NAAQS			WAAQS			Representative Concentrations		
		(ppm)	(ppb)	($\mu g/m^3$)	(ppm)	(ppb)	($\mu g/m^3$)	(ppm)	(ppb)	($\mu g/m^3$)
Sulfur Dioxide	1 hour[9]	0.075	75	195	0.075	75	195	0.004	4	10.5
	24-hour[10]	N/A	N/A	N/A	N/A	N/A	N/A	0.02	20	52
	Annual[11]	N/A	N/A	N/A	N/A	N/A	N/A	0.000	0	0

Source: BLM 2004c; Wyoming DEQ 2012

[1]Not to be exceeded more than once per year. Data (2nd high) collected at Yellowstone National Park during 2011.

[2]To attain this standard, the 3-year average of the 98th percentile of 1-hour concentrations at each monitor within an area must not exceed 100 ppb. 3-year average of the 98th percentile 1-hour concentrations for Thunder Basin 2009-2011

[3]To attain this standard, the annual average concentration in the calendar year must be less than or equal to 53 ppb. Thunder Basin annual average concentration for 2011.

[4]To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 75 ppb. Design value (2009 to 2011) for the Thunder Basin National Grasslands site.

[5]Not to be exceeded more than once per year on average over 3 years. 2011 maximum PM_{10} concentration at Campbell County Air Quality Monitoring Station. Data Source: EPA's Air Quality System Quick Look Report (AQS ID: 56–005–0456–81102).

[6]To attain this standard, the 3-year average of the annual means must be below 50 $\mu g/m^3$. 3-year average of the weighted annual mean PM_{10} concentrations at Campbell County Air Quality Monitoring Station. Data Source: EPA's Air Quality System Quick Look Report (AQS ID: 56–005–0456). Years 2009–2011.

[7]To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor in an area must not exceed 35 $\mu g/m^3$. 3-year average of the 98th percentiles of 24-hour average $PM_{2.5}$ concentration at Highland Park, Sheridan Air Quality Monitoring Station. Data Source: EPA's Air Quality System Quick Look Report (AQS ID: 56–033–0003–88101). Years 2009–2011.

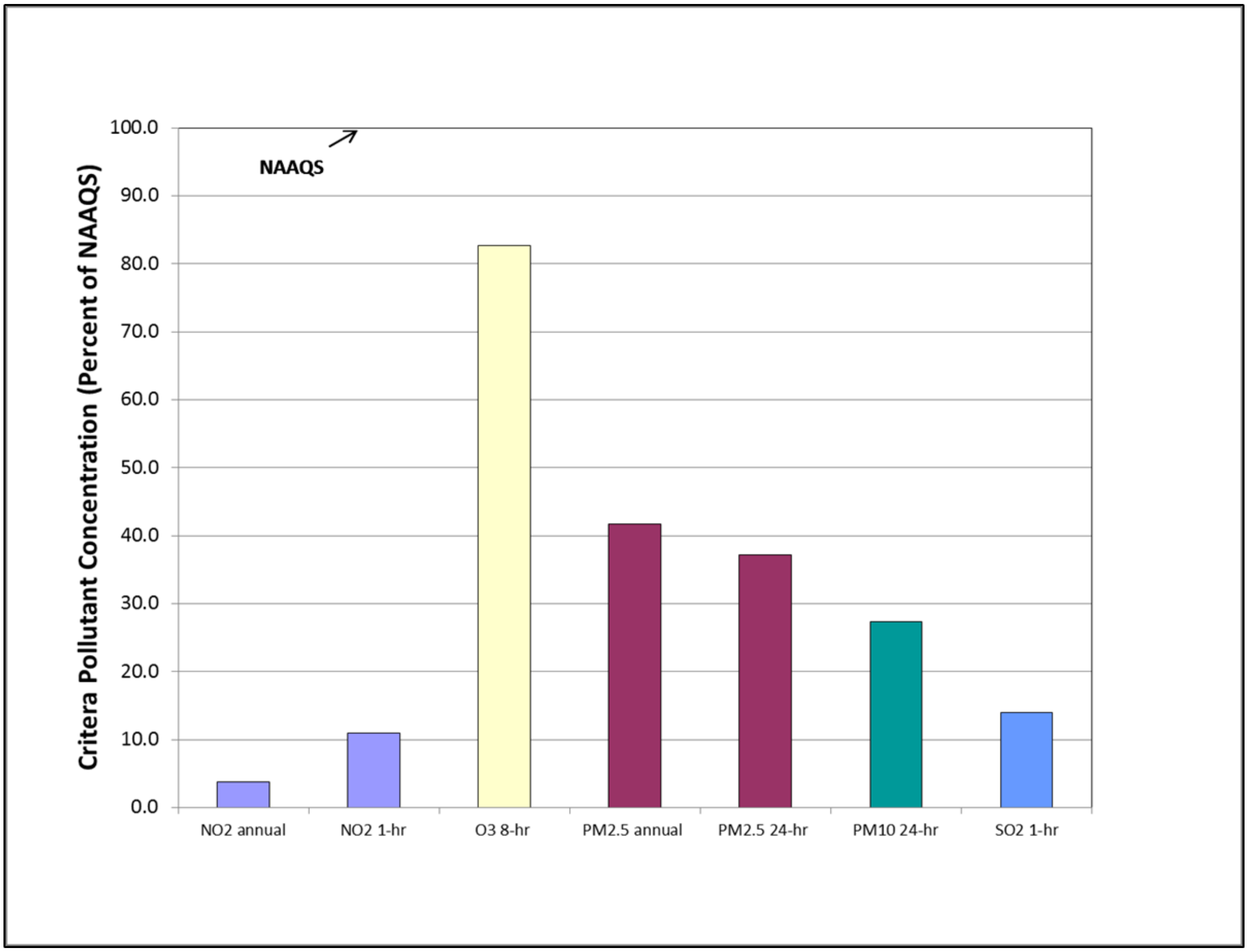
[8]To attain this standard, the 3-year average of the weighted annual mean concentrations from single or multiple community-oriented monitors must not exceed 12.0 $\mu g/m^3$. 3-year average of the annual mean $PM_{2.5}$ concentration at Highland Park, Sheridan Air Quality Monitoring Station. Data Source: EPA's Air Quality System Quick Look Report (AQS ID: 56–0333–0003–88101). Years 2009-2011.

[9]To attain this standard, the 3-year average of the 99th percentile of 1-hour concentrations at each monitor within an area must not exceed 100 ppb. 3-year average of the 99th percentile 1-hour concentrations for Wyoming Refinery, Newcastle, WY site for 2009-2011.

[10]2011 maximum SO_2 concentration at Cheyenne NCore Air Quality Monitoring Station. Data Source: EPA's Air Quality System Quick Look Report (AQS ID: 56–021–0100–42401).

[11]2011 maximum SO_2 concentration at Cheyenne NCore Air Quality monitoring Station. Data Source: EPA's Air Quality System Quick Look Report (AQS ID: 56–021–0100–42401).

EPA Environmental Protection Agency
n/a not applicable
NAAQS National Ambient Air Quality Standards
$PM_{2.5}$ particulate matter with an aerodynamic diameter equal to or less than 2.5 microns
PM_{10} particulate matter with an aerodynamic diameter equal to or less than 10 microns
ppm parts per million
ppb parts per billion
$\mu g/m^3$ micrograms per cubic meter
SLAMS State and Local Air Monitoring System
WAAQS Wyoming Ambient Air Quality Standards
WARMS Wyoming Air Resource Monitoring System



Source: WARMS 2013

NAAQS National Ambient Air Quality Standards
NO_2 nitrogen dioxide
PM_{10} particulate matter with an aerodynamic diameter equal or less than 10 microns
$PM_{2.5}$ particulate matter with an aerodynamic diameter equal or less than 2.5 microns
SO_2 sulfur dioxide

Note: The representative maximum pollutant concentrations as a percentage of the NAAQS were calculated using the values in Table 3.3, "Applicable National and State Primary Air Quality Standards for Criteria Pollutants and Recent Representative Concentrations for the Planning Area" (p. 192), which also provides the location and time period associated with monitoring data.

Figure 3.1. Representative Maximum Pollutant Concentrations in the Buffalo Planning Area as a Percentage of the NAAQS

Summary of Air Quality Modeling Studies of the Powder River Basin

During the last decade, a number of studies have been conducted to evaluate the potential effects of emissions from natural resource development sources and activities in the Buffalo planning area, primarily associated with coal and coalbed natural gas (CBNG) development in the Powder River Basin (PRB). Several of these air quality impact assessment studies for the PRB have included air quality modeling and related activities such as the development of comprehensive emission inventories. The studies summarized below exemplify the types of analyses that have been conducted or are ongoing in the Buffalo planning area that not only include estimates of the expected increases in criteria pollutant emissions from these activities, but also examine their potential future year impacts on air quality concentrations using air quality modeling tools.

PRB-I

In 2002, Argonne National Laboratory conducted an air quality impact assessment for the PRB, referred to as PRB-I. The geographic area of interest included the Montana and Wyoming portions of the PRB. The primary focus of the study was to examine potential air quality impacts from CBNG and conventional oil and gas (O&G) development sources in the Wyoming and Montana portions of the PRB. Prior studies focused on Wyoming only and Montana only, but this study was conducted for the two areas combined. At the time of the assessment, development was expected to occur over a 20-year period for the Montana portion of the PRB, and over a 10-year period for the Wyoming portion.

The assessment included the application of the CALPUFF air quality model (version 5) using MM5/CALMET-derived meteorological inputs for 1996 and emission inputs for a base year of 2000. The modeling domain included most of Wyoming and Montana and portions of North Dakota, South Dakota, and Nebraska. The assessment focused on criteria pollutants (NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$), HAPs, visibility, and atmospheric deposition to lakes (lake chemistry). Ozone was not addressed due to limitations of the CALPUFF modeling system.

CALPUFF was used to estimate direct, indirect, and cumulative near-field and far-field air quality impacts for comparison with air quality standards and PSD increments. The study considered four development alternatives for Wyoming project sources. Near-field modeling focused on project sources located in Wyoming found that:

- For all four alternatives, the concentration increases due to the emissions from the Wyoming project sources are expected to be less than the maximum allowable PSD increments for Class II areas, representing percentages equal to or less than about 32, 3, and 67% of the maximum allowable Class II PSD increments for NO_2, SO_2, and PM_{10}, respectively.
- HAPs impacts are expected to be small, except for formaldehyde.

Far-field modeling results indicated that:

- The maximum far-field impacts of criteria air pollutants due to the Wyoming project source emissions were shown to occur at the Northern Cheyenne Indian Reservation, the closest Class I sensitive receptor area.
- The concentration increases in NO_2, SO_2, and PM_{10} due to the Wyoming project emissions are expected to be less than the maximum allowable PSD increments for all mandatory Class I areas and all alternatives. The concentration increases attributable to the emissions from Wyoming project sources are lower than those attributed to non-Wyoming project source emissions for all criteria pollutants examined.
- The number of days per year with visibility degradation equal to or greater than 1 deciview due to emissions from the Wyoming project sources was estimated to be on average approximately 4 days for the Preferred Alternative (at the sensitive receptors). The highest value (20 days) was modeled at the Crow Indian Reservation under the Preferred Alternative.
- For Florence Lake, the estimated potential change in acid neutralizing capacity (ANC) due to emissions from all sources under the Preferred Alternative is slightly above 10%, which is the limit of acceptable change (LAC) threshold for lakes with background ANC values greater than 25 microequivalents per liter (μeq/L), as used for this study. For Upper Frozen Lake, the estimated potential change in ANC is greater than 1 μeq/L, which is the LAC threshold for

lakes with background ANC values less than 25 μeq/L. In both cases, the impact is mostly due to non-Wyoming sources, likely because the lakes are generally upwind of the PRB.
- For other sensitive lakes, the estimated potential changes in (ANC) due to Wyoming project sources and cumulative sources for all alternative combinations evaluated are less than 10% (the applicable LAC threshold for lakes with background ANC values greater than 25 μeq/L).

Finally, the assessment report indicated that mitigation options for NO_2 and fugitive dust were to be considered.

PRB Coal Review

Four studies comprise the PRB Coal Review (ENSR 2005a). These focused on current conditions (for 2002), and cumulative effects for three (at the time) future years including 2010, 2015, and 2020.

Current Conditions

To establish the current conditions, ENSR (ENSR 2005a) prepared a summary of 2002 air quality in the PRB area. The Wyoming portion of the study area included Campbell, Sheridan, and Johnson counties excepting the Bighorn National Forest lands to the west of the PRB, and the northern portion of Converse County. The Montana portion of the PRB study area included portions of Rosebud, Custer, Powder River, Big Horn, and Treasure counties (where coal mines are located).

This assessment of current conditions included the application of the CALPUFF air quality model (version 5) using MM5/CALMET-derived meteorological inputs for 1996 and emission inputs for a base year of 2002. The modeling domain included most of Wyoming, southeastern Montana, southwestern North Dakota, western South Dakota, and western Nebraska. The assessment focused on criteria pollutants (NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$), HAPS, visibility, and acid deposition. Impacts from different source groups were evaluated, including CBNG sources, coal-related sources, coal mines, non-coal sources, power plants, Wyoming sources, Montana sources, and all sources.

Modeled impacts of the cumulative sources showed predicted values that were greater than the 24-hour PM_{10} standards at near-field receptors, both in Wyoming and Montana. These impacts are primarily attributable to nearby sources and result in concentrations that exceed the NAAQS by approximately 15% for the Montana receptors and by more than a factor of two for the Wyoming receptors. These impacts only affect the near-field receptors. Modeled impacts of other criteria air pollutants were shown to be well below the NAAQS as well as the individual state AAQS for all receptors. Visibility in Class I and in sensitive Class II areas was affected with impacts above 1 deciview for several modeled days. Impacts on acid deposition were shown to be well below established guidelines.

The CALPUFF results were used to quantify the relative impacts from sources/source categories for each receptor. Results vary by receptor, pollutant and AQRV. Coal-related (and CBNG) sources were shown to have their greatest impacts at the near field receptors. Coal-related sources were estimated to comprise 50% or more of the overall (all sources) impact at numerous Class I and Class II receptors. CBNG was associated with up to 30% of the coal-related impact – this varied by receptor, pollutant and AQRV.

Cumulative Effects 2010

ENSR (ESNR 2006) conducted additional modeling to examine the effects of Reasonably Foreseeable Development (RFD) for 2010. The modeling approach was the same as that used to establish the current conditions, except that emissions from existing sources were adjusted to represent 2010 levels in accordance with RFD. The types of sources considered included power plants, coal mines, conventional oil and gas, CBNG, and other coal-related energy development sources.

This study examined two scenarios, a lower production (or development) scenario and a higher production scenario. The study evaluates impacts on air quality and air quality-related values resulting from projected development of RFD activities in the study area. For Wyoming, these include coal mine development as well as coal-related activities (i.e., railroads, coal-fired power plants, major transmission lines, and coal technology projects) and non-coal-related activities (i.e., other mines, CBNG, conventional oil and gas, major transportation pipelines, and key water storage reservoirs) in the Wyoming PRB study area. For Montana, these include coal mine development and coal-related activities in the Montana PRB study area.

For both development scenarios, the modeled near-field concentrations for all criteria pollutants were shown to increase in accordance with the increase in emissions. Maximum 24-hour $PM_{2.5}$ concentrations for the Wyoming receptors were estimated to be 13% higher (compared to current conditions) for the lower development scenario and 31% higher for the upper development scenario. Annual $PM_{2.5}$ concentrations for the Wyoming receptors were estimated to be 15% higher for the lower development scenario and 35% higher for the upper development scenario. The results are similar for the Montana receptors. For both receptor groups (Wyoming and Montana), modeled impacts above the ambient standard occurred at a small number of near-field receptors, and impacts decrease dramatically away from these locations.

Modeled visibility impacts at the identified Class I areas indicated an increase in the number of days with impacts above 1 deciview. The greatest visibility impacts were modeled at Badlands, Theodore Roosevelt, and Wind Cave National Parks, with an increase in the number of days exceeding 1 deciview of less than or equal to 26 days per year. The modeling results indicated a greater increase in the number of days with degraded visibility at certain of the Class II areas, including Agate Fossil Beds National Monument (30 days), Fort Laramie National Historic Site (30 days), and Soldier Creek Wilderness Area (29 days).

For acid deposition of nitrogen and sulfur compounds, the modeling results indicated substantial percentage increases in deposition under the lower and upper development scenarios. Impacts were estimated to be below the threshold values (with the exception of Florence Lake and Upper Frozen Lake). In this study, the modeled impacts were primarily attributable to coal-related sources and power plants, including sources from both Montana and Wyoming.

Model results selected HAPs emissions (benzene, ethyl benzene, formaldehyde, n-hexane, toluene, and xylene) for the 2010 upper development scenario estimated impacts to be above the acute Reference Exposure Level (REL) for formaldehyde at two receptors in Wyoming. The modeled impacts for the 2010 lower development scenario reflected the same patterns as the 2002 base year.

Cumulative Effects 2015

ENSR (ESNR 2008) conducted additional modeling to examine the effects of RFD for 2015. The modeling approach was the same as that used for the current conditions and 2010 analyses, but an updated version of the CALPUFF model (version 5.8) was used and the model inputs were also updated. MM5/CALMET-derived meteorological inputs for 2003 were used. The emissions inputs were derived using 2004 base-year emissions projected to 2015. The types of sources considered included power plants, coal mines, conventional oil and gas, CBNG, and other coal-related energy development sources.

For the Wyoming near-field receptors, the 24-hour PM_{10} and $PM_{2.5}$ concentrations included localized values that were greater than the NAAQS for the base year (2004), as well as for both development scenarios for 2015. The modeling results for the 2015 development scenarios indicated an increase in concentration of about a factor of two, relative to the base year for these parameters, primarily due to CBNG operations and coal mining activities. Additionally, a 30 to 50% increase of annual PM_{10} and $PM_{2.5}$ concentrations at the Wyoming near-field receptors was also predicted. This level of increase would lead to values greater than the annual standards for both PM_{10} and $PM_{2.5}$. Impacts of NO_2 and SO_2 emissions are predicted to be below the NAAQS and WAAQS at the Wyoming near-field receptors.

Modeled impacts at Montana near-field receptors indicated compliance with the NAAQS and the Montana AAQS for all pollutants and averaging periods except the 1-hour NO_2.

Modeled visibility impacts at Class I and Class II areas showed an increase in the number of days with impacts above 1 deciview, compared to the 2004 base year, by as much as 36 days for the lower development scenario 47 days for the upper development scenario.

For acid deposition of nitrogen and sulfur compounds, the modeling results indicated substantial percentage increases in deposition under the lower and upper development scenarios. Impacts were estimated to be below the threshold values (with the exception of Florence Lake and Upper Frozen Lake). As for 2010, the modeled impacts were primarily attributable to coal-related sources and power plants, including sources from both Montana and Wyoming.

Model results for the base year (2004) and 2015 development scenarios predicted impacts to be well below the acute RELs, Reference Concentrations for Chronic Inhalation, and carcinogenic risk threshold for hazardous air pollutants. Benzene exposure was predicted to increase by 50% as a result of projected PRB development, but even with this increase the risk is below carcinogenic risk thresholds.

Cumulative Effects 2020

AECOM (ESNR 2009b) conducted additional modeling to examine the effects of RFD for 2020. The modeling approach was the same as that used for the 2015 analyses.

For the Wyoming near-field receptors, the modeled impact of the 24-hour PM_{10} and $PM_{2.5}$ concentrations showed localized values greater than the NAAQS for the base year (2004), as well as for both development scenarios for 2020. For the 2020 development scenarios, concentrations of these parameters were shown to increase by a factor of 2.5 relative to the base year, primarily due to CBNG operations and coal mining activities. Annual PM_{10} and $PM_{2.5}$ concentrations at peak Wyoming near-field receptors were shown to increase by about 20%, commensurate with modeled values greater than the annual standards for $PM_{2.5}$. Impacts of NO_2 and SO_2 emissions were predicted to be below the NAAQS and Wyoming AAQS at the Wyoming near-field receptors.

Modeling results for the Montana near-field receptors showed compliance with the NAAQS and the Montana AAQS for all pollutants and averaging periods. The 1-hour NO_2 concentrations at

Montana near-field receptors were predicted to exceed the AAQS for 2015, but not for 2020. The authors suggest that this is due to a southward relocation of CBNG wells.

Modeled visibility impacts at Class I and Class II areas were shown to increase in the number of days with impacts above 1 deciview, compared to the 2004 base year, by up to 59 days for the lower development scenario and up to 60 days for the upper development scenario.

The model results indicated that the increased deposition, especially from SO_2 emissions from power plants, contributed to modeled values greater than the ANC thresholds at Florence Lake and Upper Frozen Lake. The authors suggest that increased growth in power plant operations (presumably especially upwind of the sensitive lakes) would further reduce the ANC of the sensitive lakes and that this issue should be carefully examined for each proposed future development project.

PRB-II

This ongoing study is another model based air quality impact assessment for the Powder River Basin (in Montana and Wyoming). Currently, the only available reference is a proposal by AECOM (2009).

The geographic area of interest is the Montana and Wyoming portions of the Powder River Basin. Types of sources to be considered include CBNG, conventional O&G development sources, and coal in the Wyoming and Montana portions of the PRB. Pollutants of interest are: criteria pollutants (ozone, NO_2, SO_2, CO, PM_{10}, $PM_{2.5}$), HAPS, visibility, deposition (lake chemistry). Note that this is the first modeling analysis to include ozone as a pollutant of interest.

The proposed modeling approach includes the use of the Weather Research and Forecasting meteorological model and the Comprehensive Air Quality Model, with Extensions photochemical air quality model. The proposed modeling domain includes a high resolution (4-kilometer) grid over the PRB study area. The analysis is expected to examine a 2008 base-year. Future-year modeling for 2020, 2030, and possibly 2035 is also proposed. The modeling analysis is in progress; results are not available at this time.

WRAP-III

To support future modeling studies of the area, Environ (2011) conducted an analysis of the criteria pollutant emissions for oil and gas exploration and production operations in the PRB. This study did not perform modeling. The study focused on emission inventory development only for the year 2006. The emissions totals for the PRB for 2006 are 21,086 tons of NO_x and 14,367 tons of VOC. Overall, compressor engines accounted for approximately 44% and drilling rigs accounted for approximately 27% of basin-wide NO_x emissions. Pneumatic devices, well fugitive devices, and compressor engines accounted for approximately 61% of basin-wide VOC emissions.

Summary

In summary, recent modeling and modeling-related studies of the PRB have provided quantitative information on the potential effects of various development scenarios on air quality and deposition throughout the region as well as the relative contribution of various sources/source categories to air quality impacts. The PRB-I modeling (using CALPUFF) showed that planned development would result in air quality impacts, including some localized values greater than the air quality standards for PM_{10} and $PM_{2.5}$, and degraded visibility at nearby Class I and Class II areas. Additional modeling conducted in support of a multi-year coal review study (also using

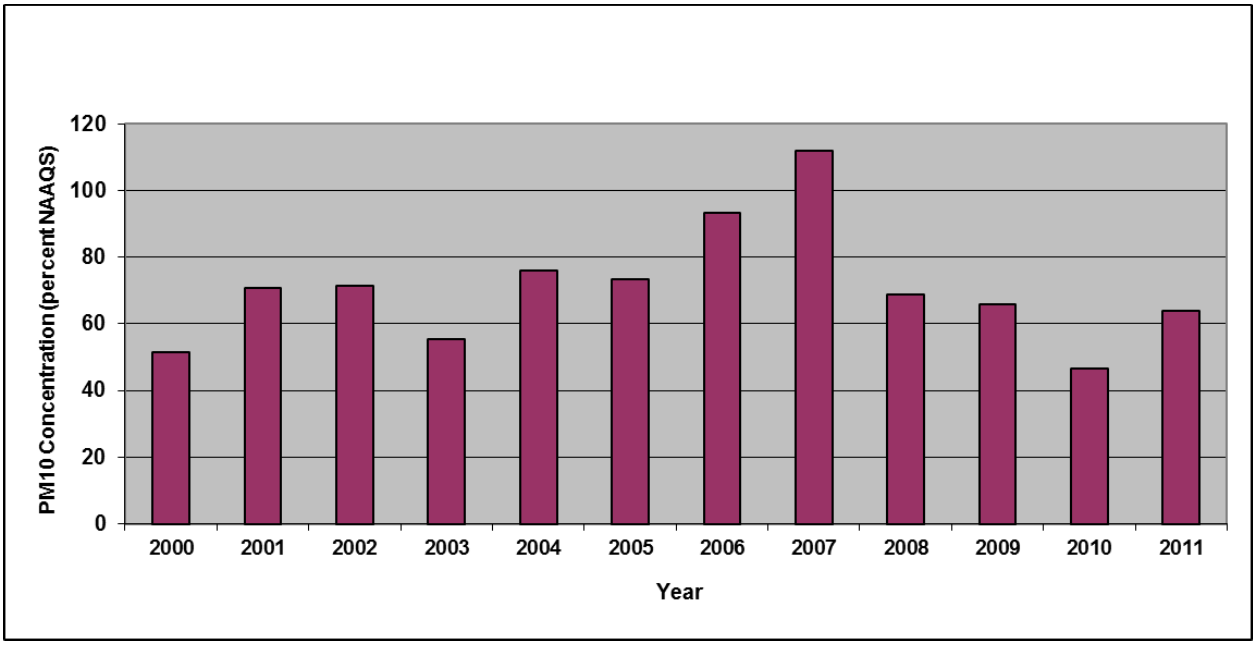
CALPUFF) found that coal-related (and CBNG) sources were shown to have their greatest impacts at the near field receptors. For a base-year of 2002, coal-related sources were estimated to comprise 50% or more of the overall impact at numerous Class I and Class II receptors. CBNG was associated with up to 30% of the coal-related impact – this varied by receptor, pollutant, and AQRV. Additional modeling for 2010, 2015 and 2020 indicated that RFD would result in air quality impacts, including some localized values greater than the air quality standards for PM_{10} and $PM_{2.5}$, degraded visibility at nearby Class I and Class II areas, and increased deposition to sensitive lakes. An additional modeling study (PRB-II) includes the use of improved, state-of-the science modeling tools (such as Weather Research and Forecasting and Comprehensive Air Quality Model, with Extensions) and is expected to extend the impacts analysis out to 2020, 2030, and possibly 2035. Two additional projects have focused on analysis of the emissions within the region, and the results from these studies may be useful for future modeling.

3.1.1.5. Trends

This section evaluates the recent trends in air quality in the Buffalo planning area by examining criteria pollutant, visibility, and deposition data collected at various monitoring sites in and near the planning area. It should be notes that no statistics were computed to quantify the actual trends or their significance attributes. Rather, all discussions below related to the various trends are derived from simple visual inspection of the data.

Air Pollutant Concentrations

Air quality data collected at the various monitors in the Buffalo planning area (see Table 3.1, “Air Quality Monitoring Sites in and Near the Buffalo Planning Area” (p. 190)) are presented for PM_{10}, $PM_{2.5}$, SO_2, and ozone. Figure 3.2, “Peak 24-Hour Average Particulate Matter Concentrations in Sheridan, Wyoming” (p. 200) shows annual peak 24-hour average PM_{10} concentrations at the Sheridan site for the period 2000 to 2011. The data are depicted as percentages of the 24-hour standard. Although the peak concentration for 2007 was over the standard, recent measurements of 24-hour PM_{10} at the Sheridan site are well below the standard, and there is a slight downward trend since 2008.

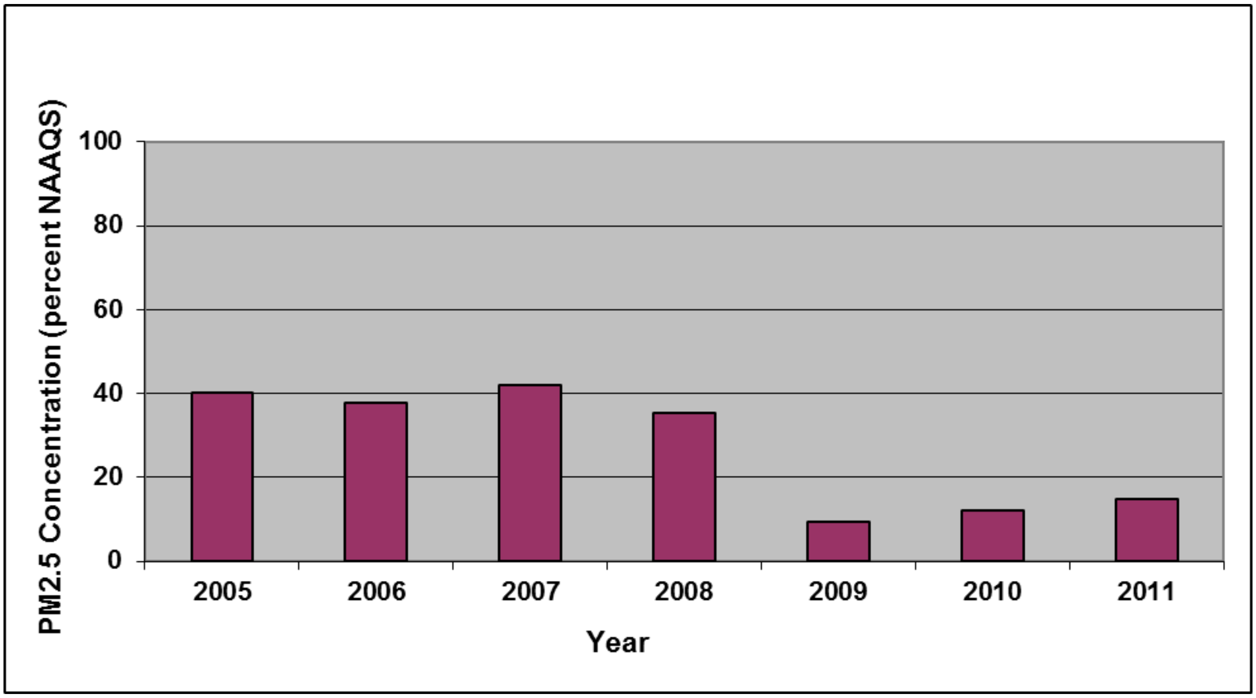


Source: WARMS 2013

NAAQS National Ambient Air Quality Standards
PM_{10} particulate matter with an aerodynamic diameter equal to or less than 10 microns

Figure 3.2. Peak 24-Hour Average Particulate Matter Concentrations in Sheridan, Wyoming

Figure 3.3, “Annual Average $PM_{2.5}$ for the Sheridan Highland Park Site” (p. 201) presents annual average $PM_{2.5}$ data collected at the Sheridan Highland Park monitor for the period 2005 to 2011. The data are plotted as a percentage of the $PM_{2.5}$ NAAQS. As for PM_{10}, concentrations of$PM_{2.5}$in the Sheridan area are well below the annual average NAAQS. Unlike the peak 24-hour average PM_{10} concentrations measured at the Sheridan County Police Station site, with values at 60% or more of the standard in recent years, concentrations of annaul average $PM_{2.5}$ in the Sheridan area are well below the annual average NAAQs.

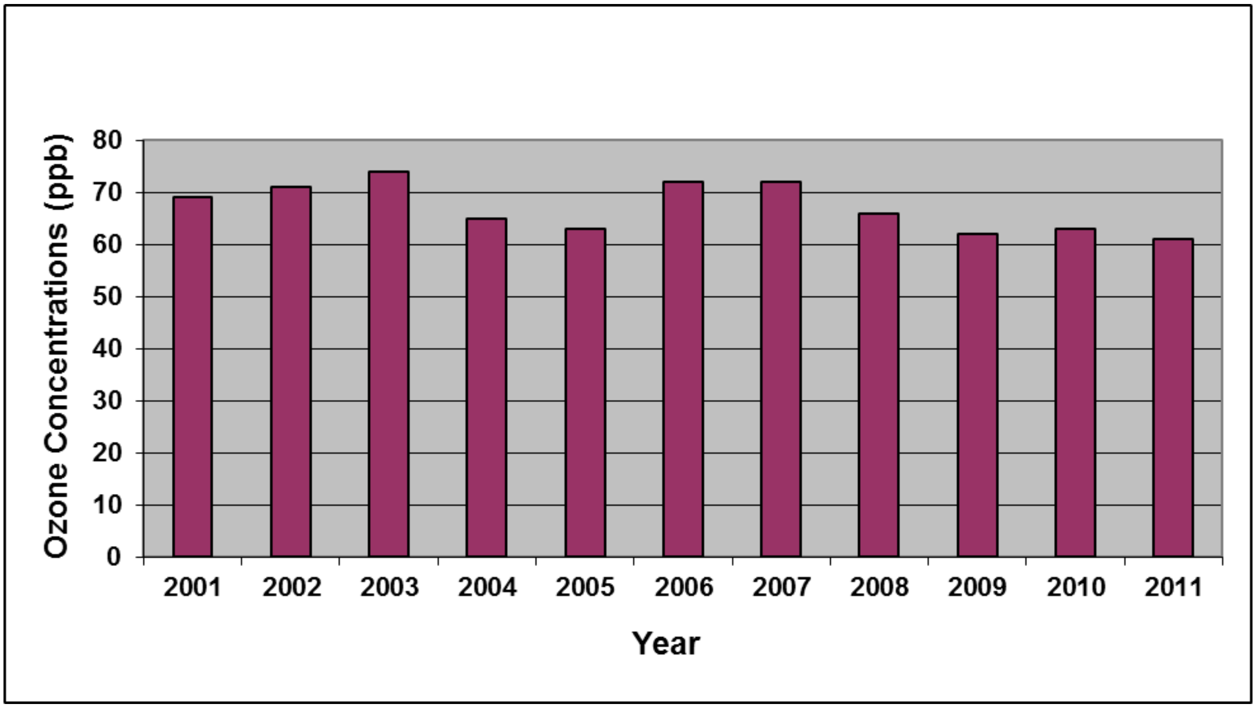


Source: WARMS 2013

NAAQS National Ambient Air Quality Standards
$PM_{2.5}$ particulate matter with an aerodynamic diameter equal to or less than 2.5 microns

Figure 3.3. Annual Average $PM_{2.5}$ for the Sheridan Highland Park Site

Figure 3.4, "Fourth Highest Eight-Hour Average Ozone for the Thunder Basin Special Purpose Monitoring Site" (p. 202) presents the fourth highest 8-hour average ozone data for the Thunder Basin site for the period 2001 to 2011. These data are used to determine the area's ozone "design value," which is calculated as the 3-year average of the fourth highest observed concentration. The most recent design value for the Thunder Basin site for the period 2009 to 2011, is 62 parts per billion (ppb), which is close to the current 8-hour ozone NAAQS of 75 ppb. Although the data vary year to year during this period, there is no discernable trend in the fourth highest 8-hour ozone concentrations at this site.

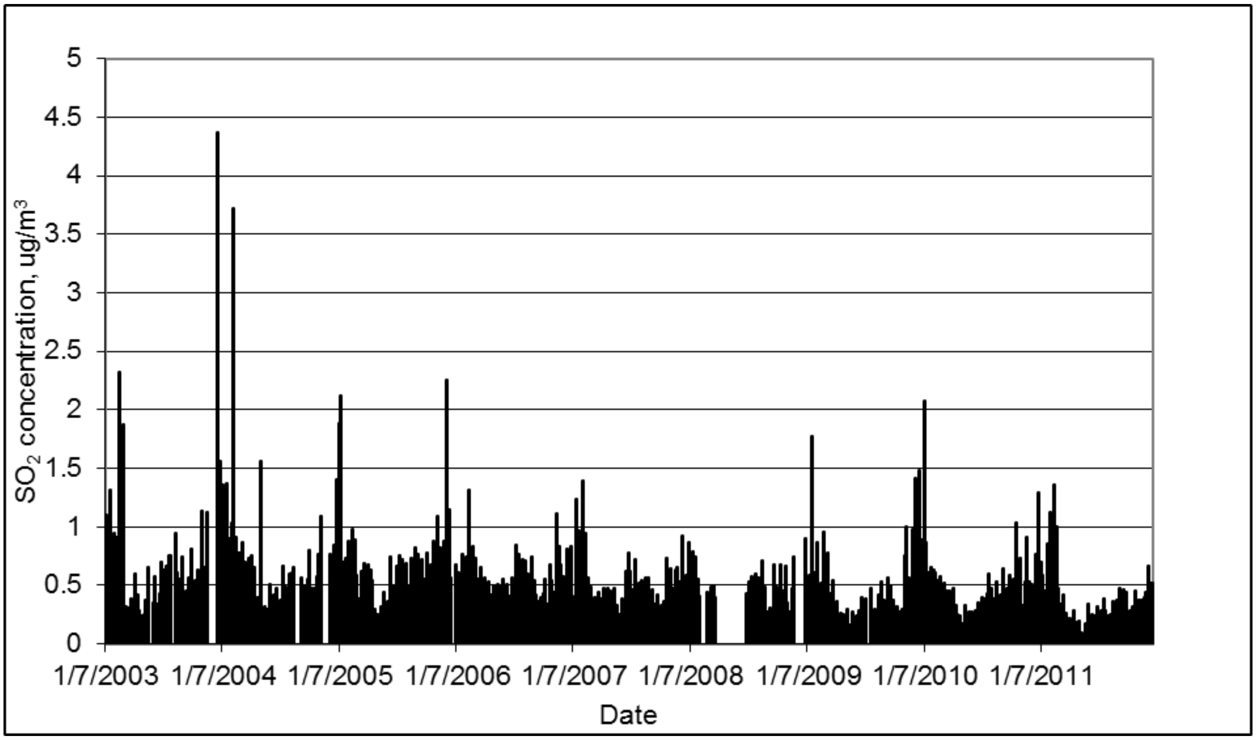


Source: Wyoming DEQ 2013

ppb parts per billion

Figure 3.4. Fourth Highest Eight-Hour Average Ozone for the Thunder Basin Special Purpose Monitoring Site

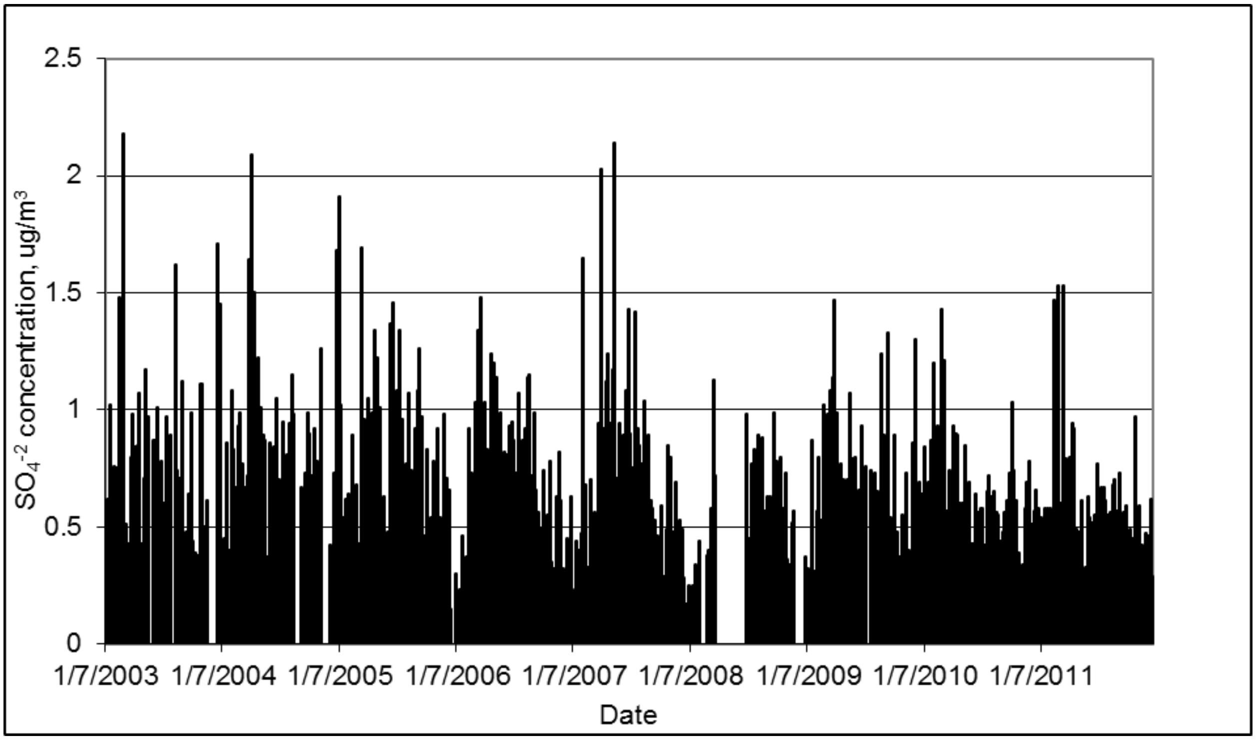
Monitoring sites at Buffalo and Sheridan as part of the WARMS network provide a summary of observed concentrations of sulfur and nitrogen compounds in the planning area. Figure 3.5, "Weekly SO_2 Concentrations (µg/m^3) – Buffalo WARMS Monitor" (p. 203) through Figure 3.8, "Weekly NH_4 Concentrations (µg/m^3) – Buffalo WARMS Monitor" (p. 206) present weekly average concentrations of SO_2, sulfate (SO_4), NO_3, and ammonium (NH_4), respectively, for the Buffalo site for the period 2003 to 2011. Figure 3.9, "Weekly SO_2 Concentrations (µg/m^3) – Sheridan WARMS Monitor" (p. 207) through Figure 3.12, "Weekly NH_4 Concentrations (µg/m^3) – Sheridan WARMS Monitor" (p. 210) present similar measures for the Sheridan site. There are data missing for a number of weeks throughout this period, especially in 2008. The data show weekly and seasonal variations in these compounds at both sites, with no real discernible long-term trends over this period. Observed concentrations of SO_2, SO_4, and NO_3, are consistently higher at the Sheridan site in the northwest portion of the planning area compared to the Buffalo site. Observations of NH_4 are comparable at both sites during this period.



Source: WARMS 2013

μg/m³ micrograms per cubic meter
SO_2 sulfur dioxide

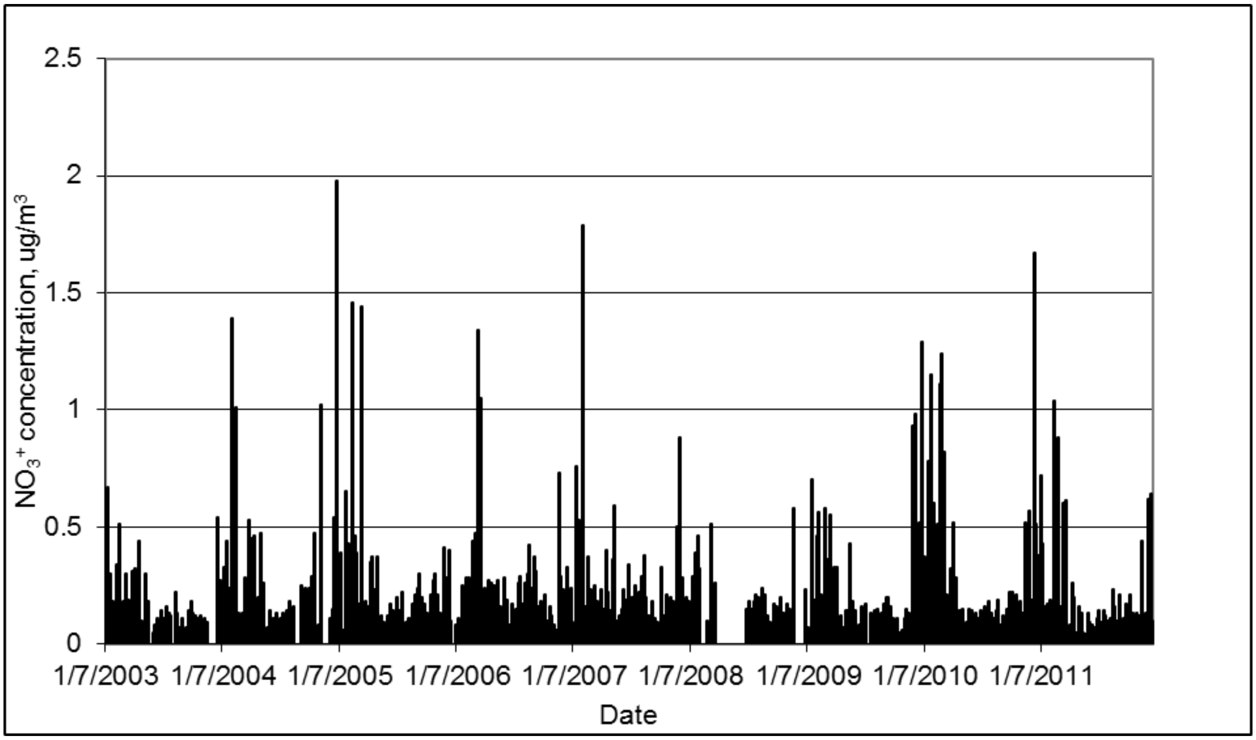
Figure 3.5. Weekly SO_2 Concentrations (μg/m³) – Buffalo WARMS Monitor



Source: WARMS 2013

μg/m³ micrograms per cubic meter
SO_4 sulfate

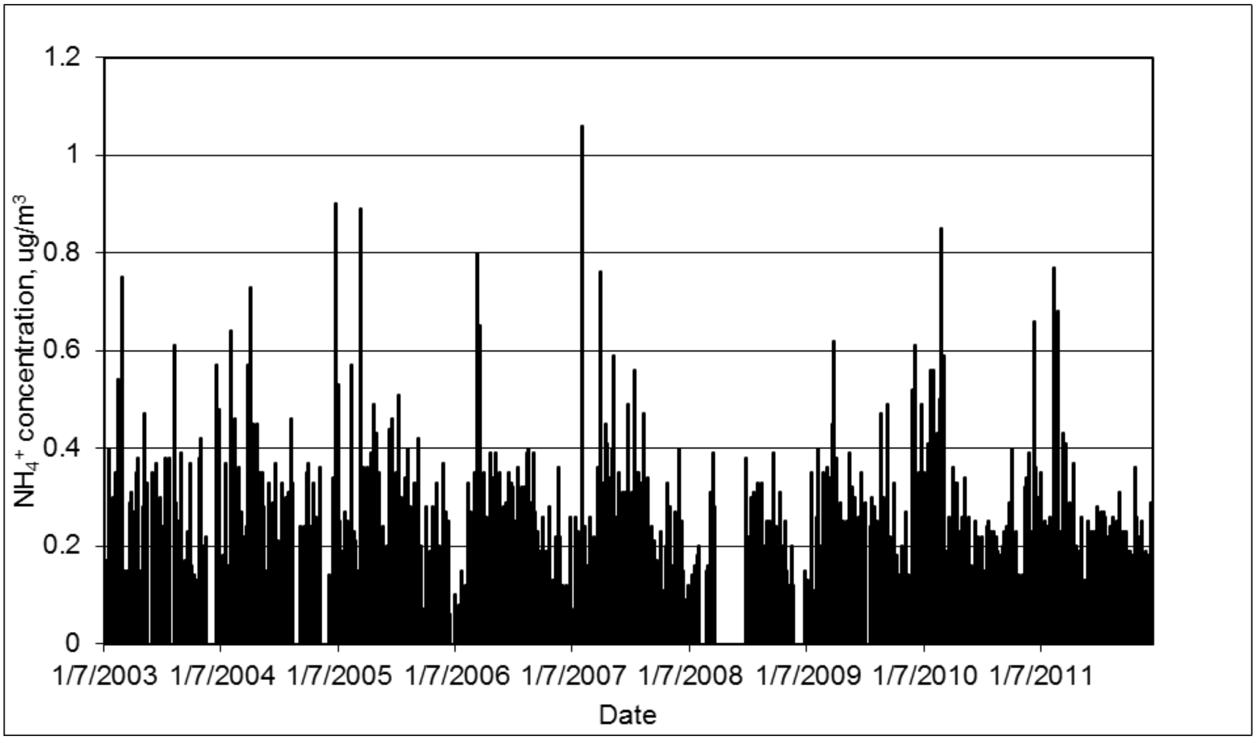
Figure 3.6. Weekly SO_4 Concentrations (μg/m³) – Buffalo WARMS Monitor



Source: WARMS 2013

ug/m3 micrograms per cubic meter
NO_3 nitrate

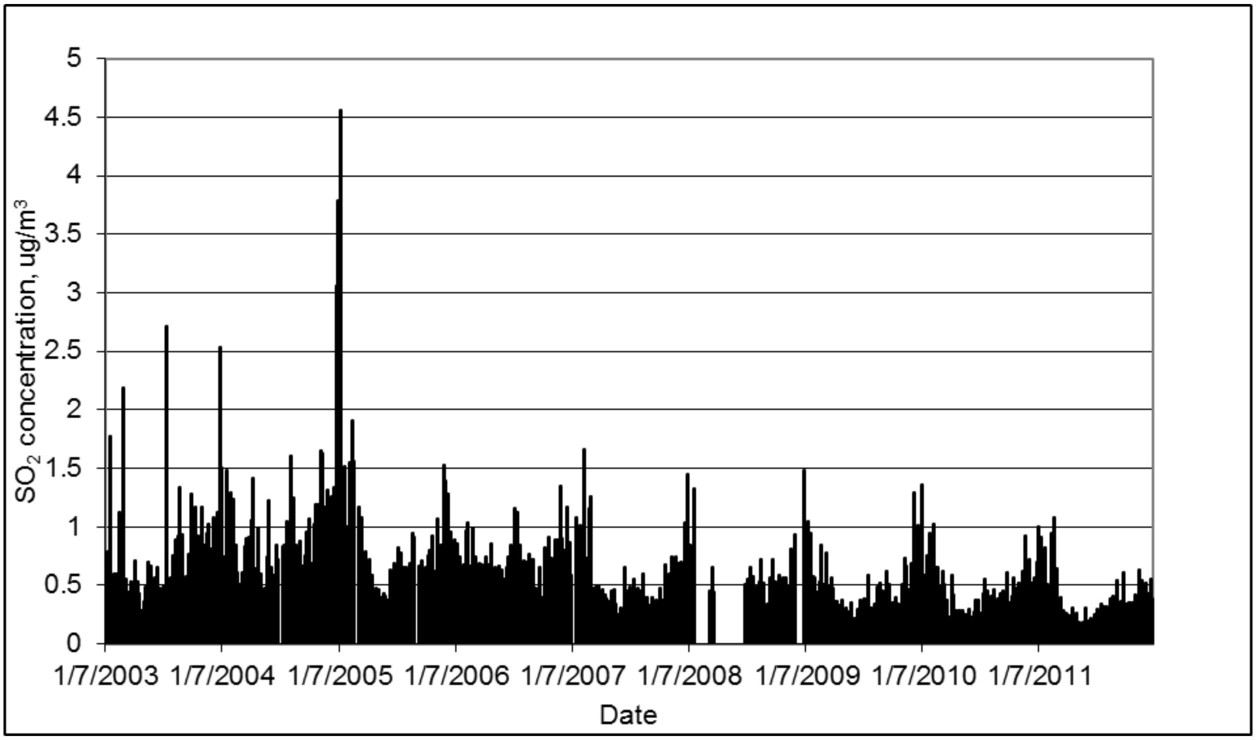
Figure 3.7. Weekly NO_3 Concentrations ($\mu g/m^3$) – Buffalo WARMS Monitor



Source: WARMS 2013

ug/m3 micrograms per cubic meter
NH_4 ammonium

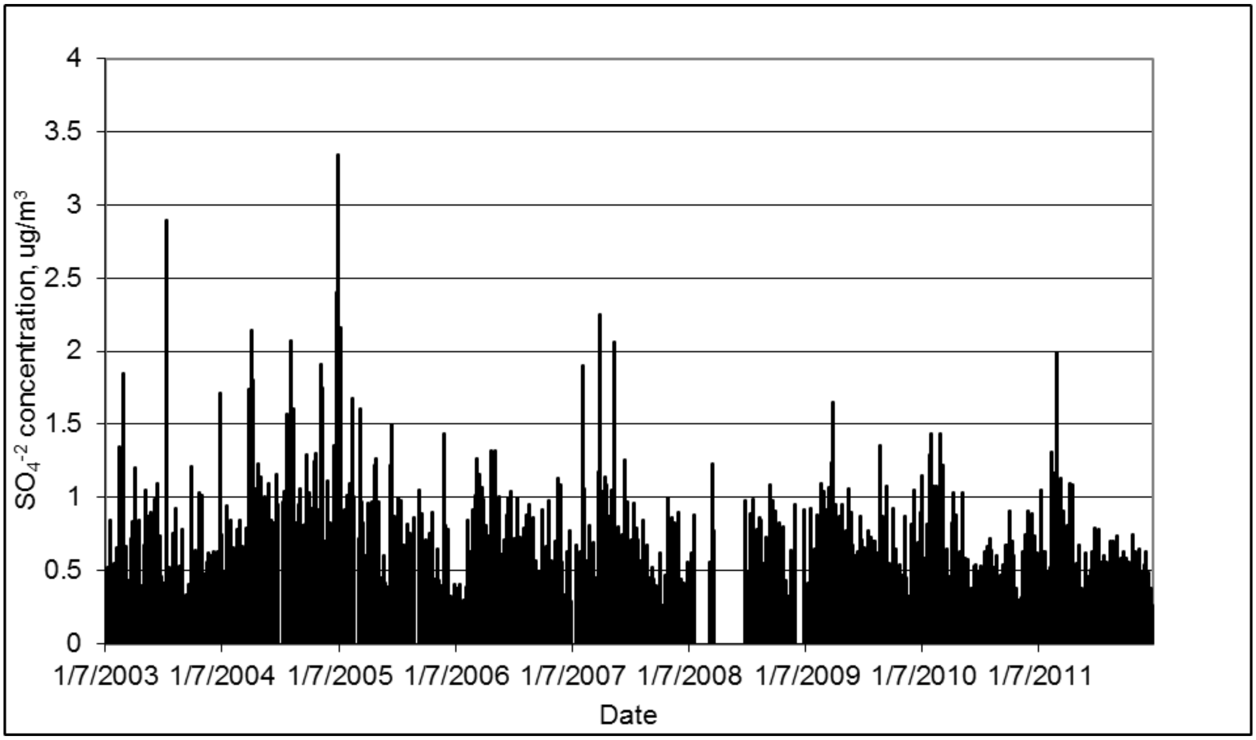
Figure 3.8. Weekly NH_4 Concentrations (μg/m3) – Buffalo WARMS Monitor



Source: WARMS 2013

ug/m³ micrograms per cubic meter
SO_2 sulfur dioxide

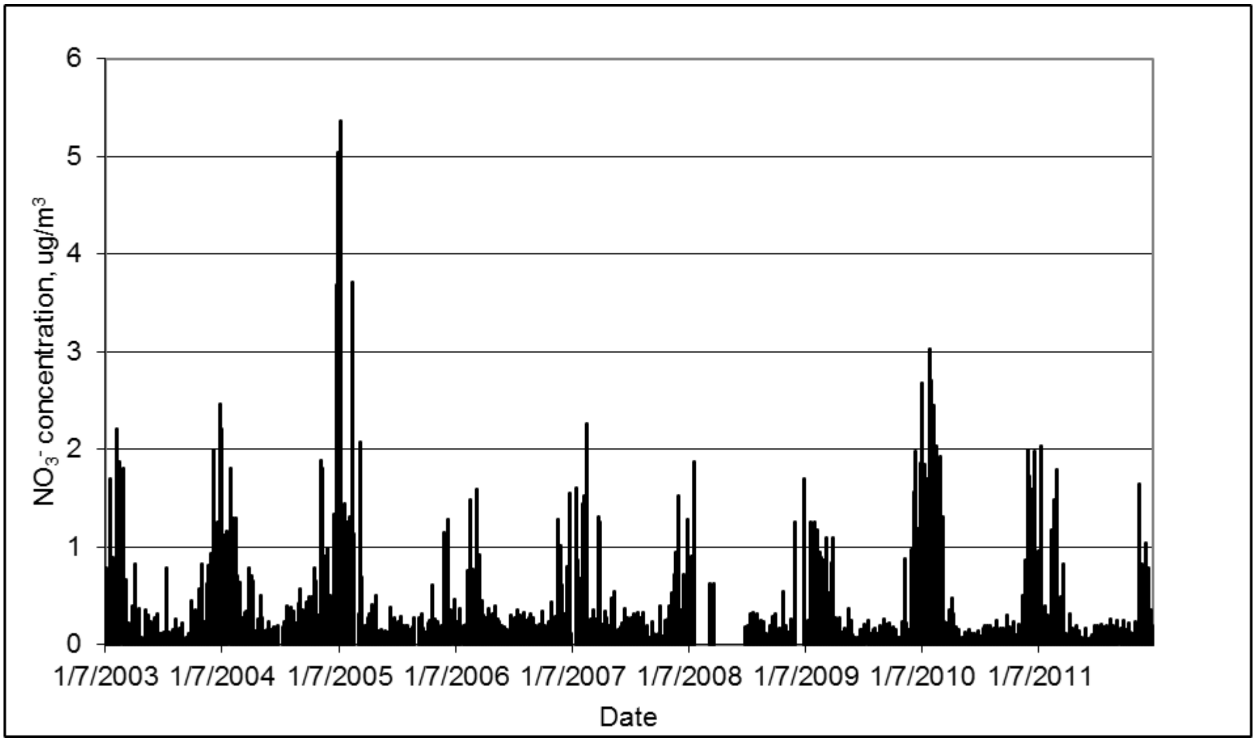
Figure 3.9. Weekly SO_2 Concentrations (µg/m³) – Sheridan WARMS Monitor



Source: WARMS 2013

ug/m^3 micrograms per cubic meter
SO_4 sulfate

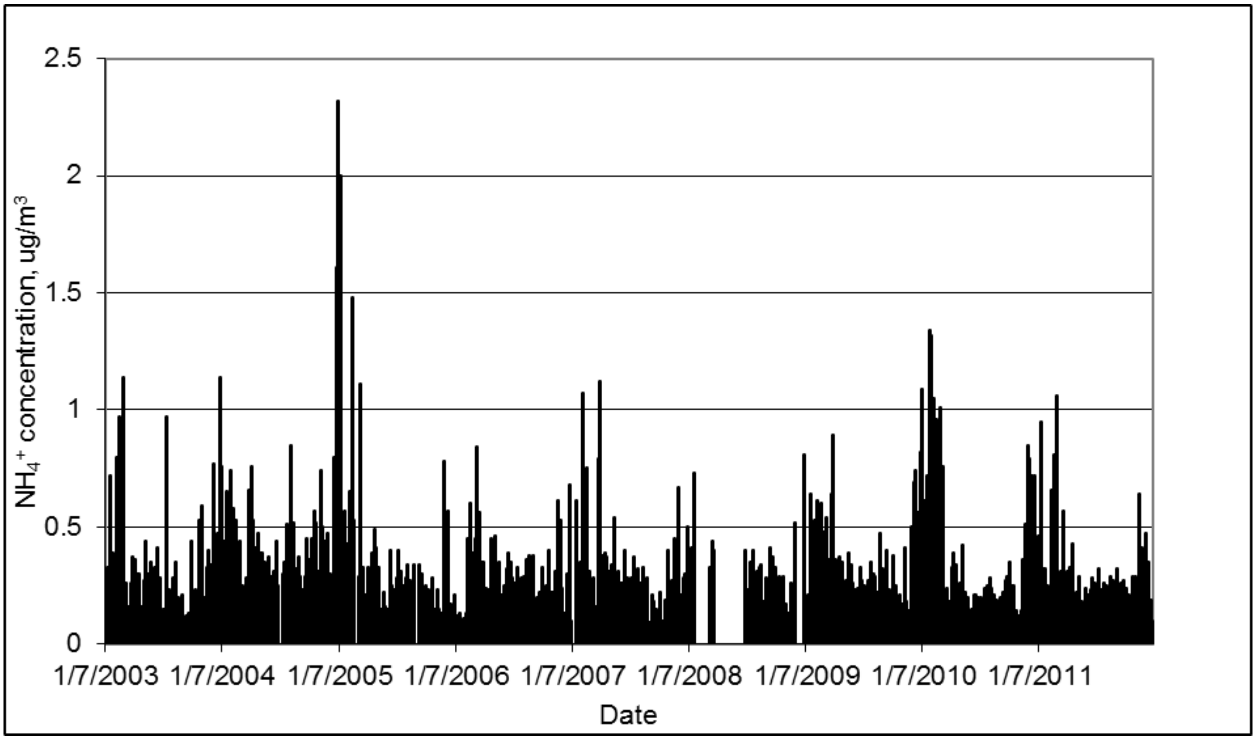
Figure 3.10. Weekly SO_4 Concentrations (µg/m^3) – Sheridan WARMS Monitor



Source: WARMS 2013

ug/m³ micrograms per cubic meter
NO_3 nitrate

Figure 3.11. Weekly NO_3 Concentrations (µg/m³) – Sheridan WARMS Monitor



Source: WARMS 2013

ug/m^3 micrograms per cubic meter
NH_4 ammonium

Figure 3.12. Weekly NH_4 Concentrations (µg/m^3) – Sheridan WARMS Monitor

Visibility

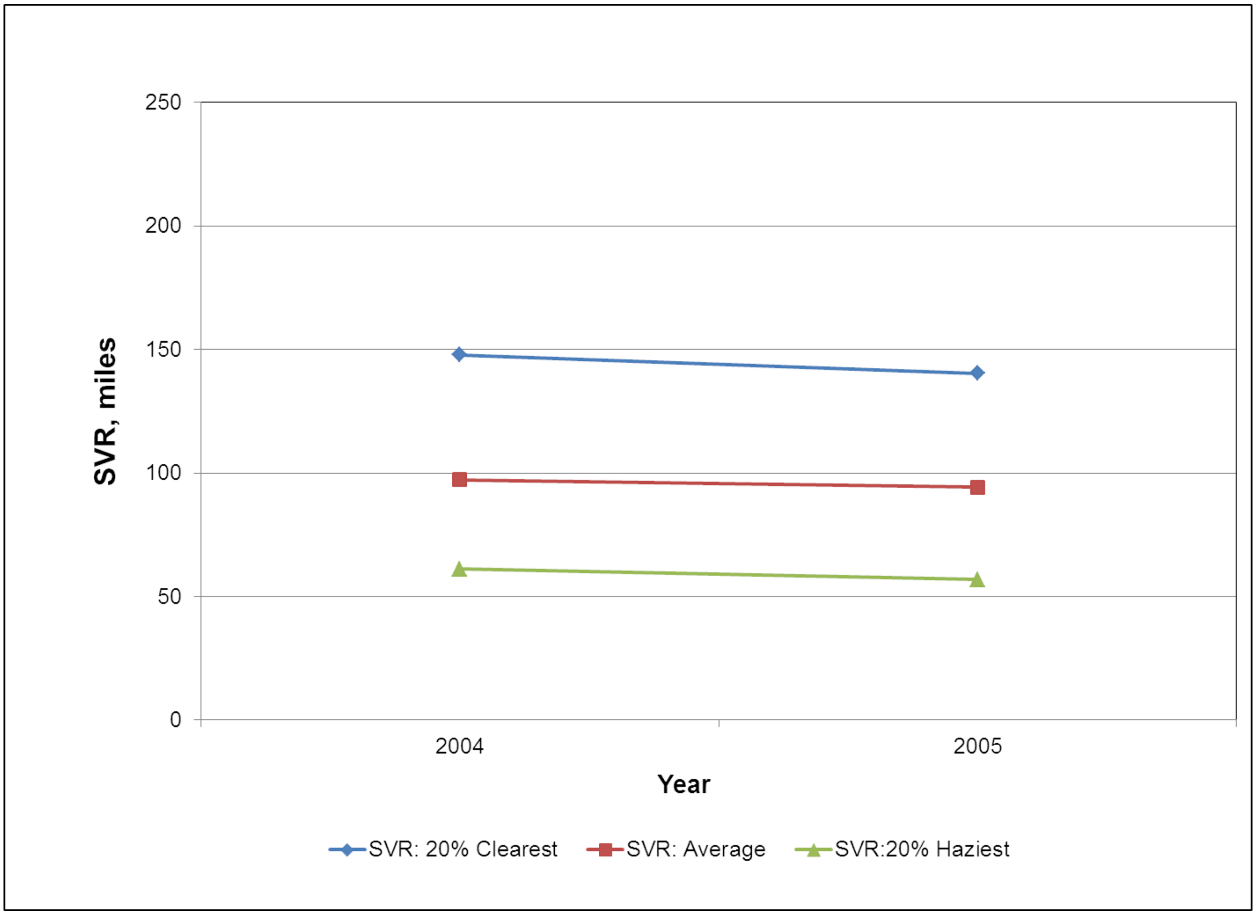
An assessment of the general trends in visibility was conducted by examining weekly and annual average SVR estimates for the Thunder Basin, Cloud Peak, and Badlands IMPROVE monitors. There are several national parks, wilderness areas, national monuments, national memorials, and national trails in or near the Buffalo planning area. Table 3.4, "Class I and Class II Areas in or near the Buffalo Planning Area" (p. 211) lists these areas, which are designated Class I or Class II areas in accordance with the CAA. Although there are a number of Class II areas in and near the Buffalo planning area, there are no Class I areas in the planning area. The nearest Class I areas are Wind Cave National Park and Badlands Wilderness Area, both in South Dakota.

Table 3.4. Class I and Class II Areas in or near the Buffalo Planning Area

Area Type	Area Name	Closest Distance to the Buffalo Planning Area (miles)	Direction from the Buffalo Planning Area	Clean Air Act Designation of the Area
National Park	Wind Cave National Park	110	East	Class I
Recreation Area	Missouri National Recreational River	275	North and East	Class II
Wilderness Areas	Cloud Peak Wilderness Area	In	Western edge of Planning Area	Class II
	Badlands Wilderness Area	150	East	Class I

Area Type	Area Name	Closest Distance to the Buffalo Planning Area (miles)	Direction from the Buffalo Planning Area	Clean Air Act Designation of the Area
National Forests	Bighorn National Forest	In	Near western edge of Planning Area	Class II
	Black Hills National Forest	20	East	Class II
	Thunder Basin National Grassland	In	Eastern quarter of Planning Area	Class II
National Monument	Devils Tower National Monument	20	East	Class II
Historic Trail	Lewis and Clark National Historic Trail	140	North	Class II
National Memorial	Mount Rushmore National Memorial	100	Eastt	Class II
Source: NPS 2006				

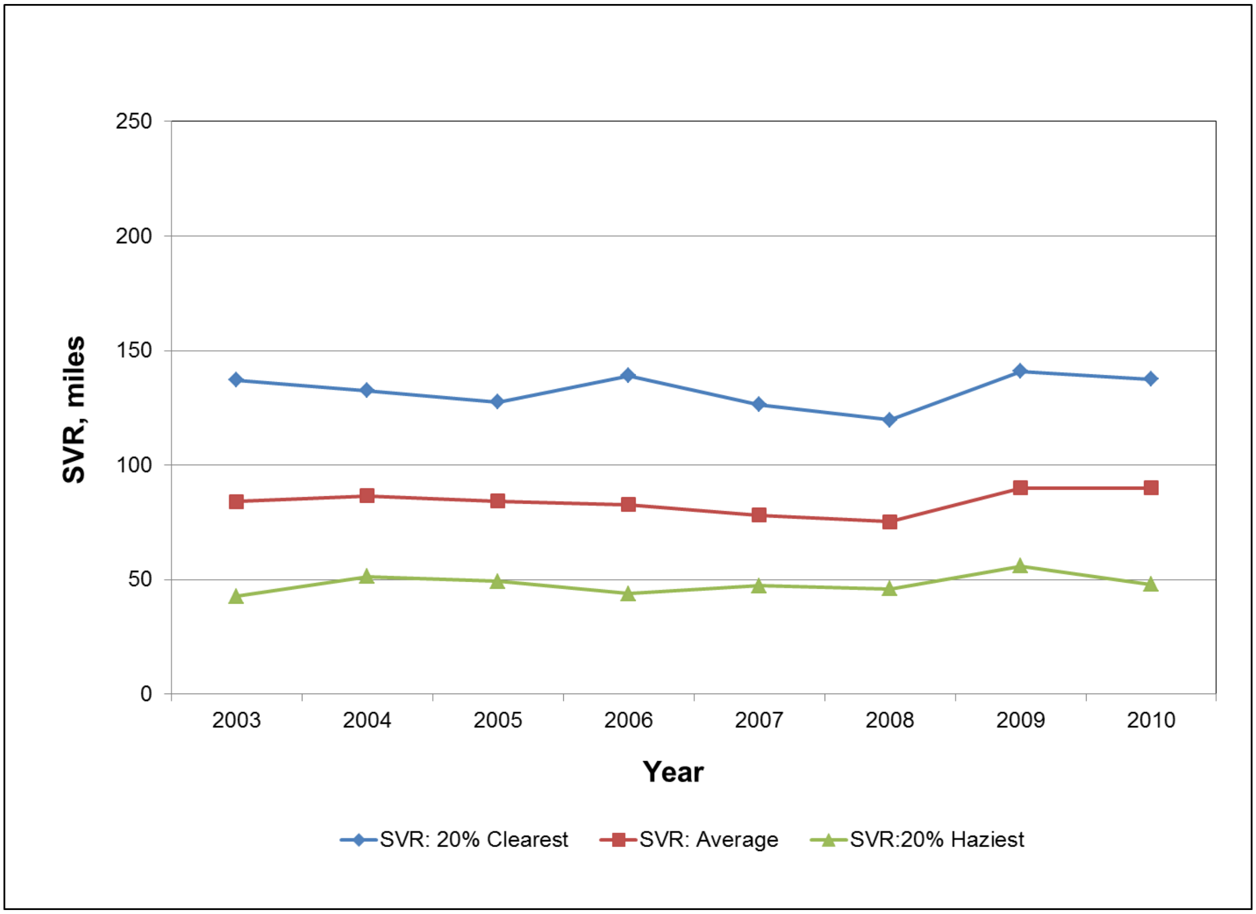
As noted above, data collected at the Thunder Basin National Grasslands and Cloud Peak Wilderness IMPROVE monitoring sites have been used indirectly to measure visibility in the planning area. Figure 3.13, “Annual Visibility (SVR) for the Thunder Basin IMPROVE Site” (p. 212) presents visibility data for the Thunder Basin IMPROVE site for the period 2004 to 2005, and Figure 3.14, “Annual Visibility (SVR) for the Cloud Peak IMPROVE Site” (p. 213) presents visibility data for the Cloud Peak IMPROVE site for the period 2003 to 2010. Figure 3.15, “Weekly Visibility (SVR) for the Thunder Basin IMPROVE Site” (p. 214) presents weekly visibility data for the Thunder Basin IMPROVE site for the period 2003 to 2010, and Figure 3.16, “Weekly Visibility (SVR) for the Cloud Peak IMPROVE Site” (p. 215) presents week visibility data for the Cloud Peak IMPROVE site for the period 2003 through 2010. According to the EPA, “In our nation’s scenic areas, the visual range has been substantially reduced by air pollution. In eastern parks, average visual range has decreased from 90 miles to 15-25 miles. In the West, visual range has decreased from 140 miles to 35-90 miles.” A comparison of these numbers and data from the two sites indicates that they are consistent and show very good to excellent visibility ranges in the planning area, even for the 20% haziest days. Although there are not enough data to discern trends at the Thunder Basin site, the 8-year record for the Cloud Peak site does show a very slight improvement in visibility during the last four years of this period. These data also show that visibility is consistently better at the Cloud Peak Wilderness site compared to the Thunder Basin site.



Source: IMPROVE 2013

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR standard visual range

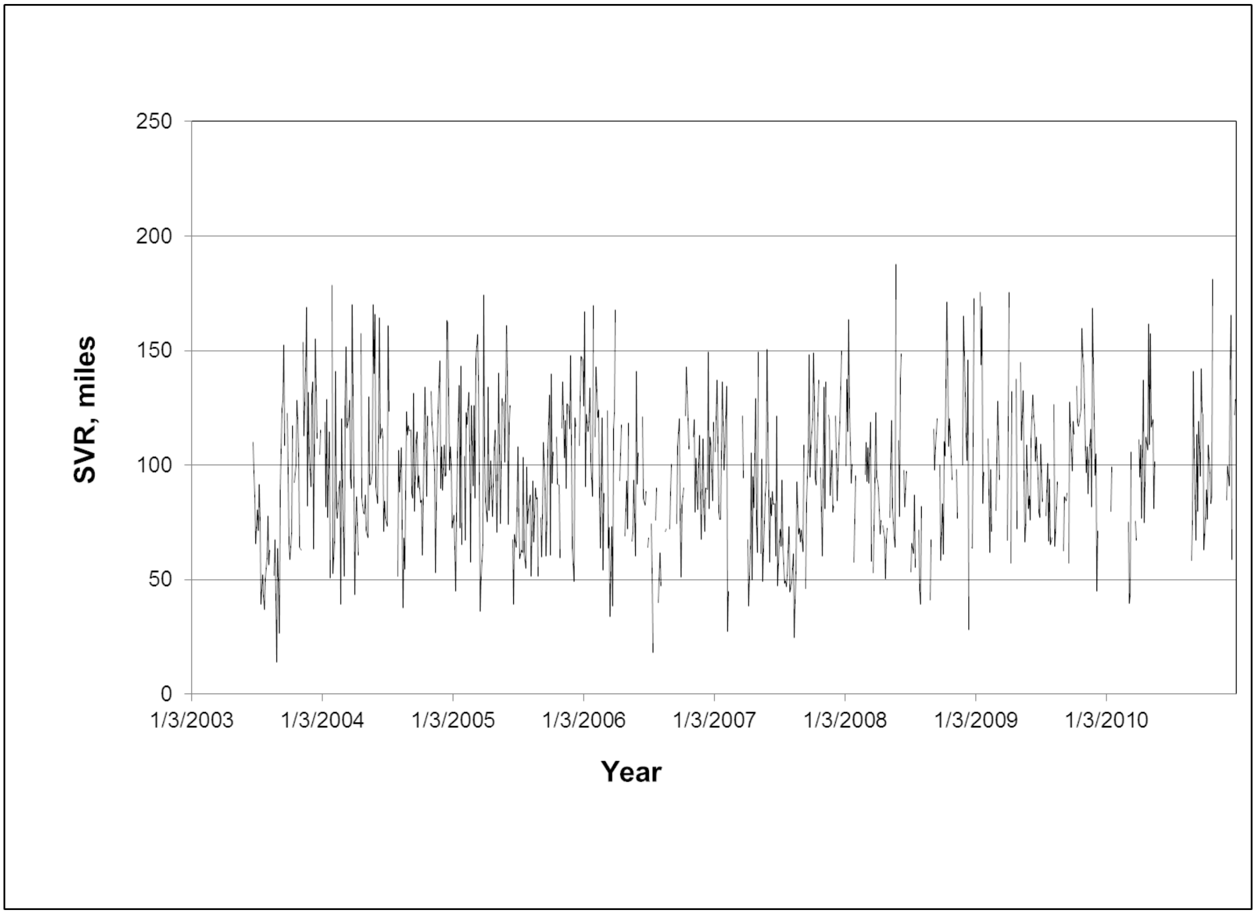
Figure 3.13. Annual Visibility (SVR) for the Thunder Basin IMPROVE Site



Source: IMPROVE 2013

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR standard visual range

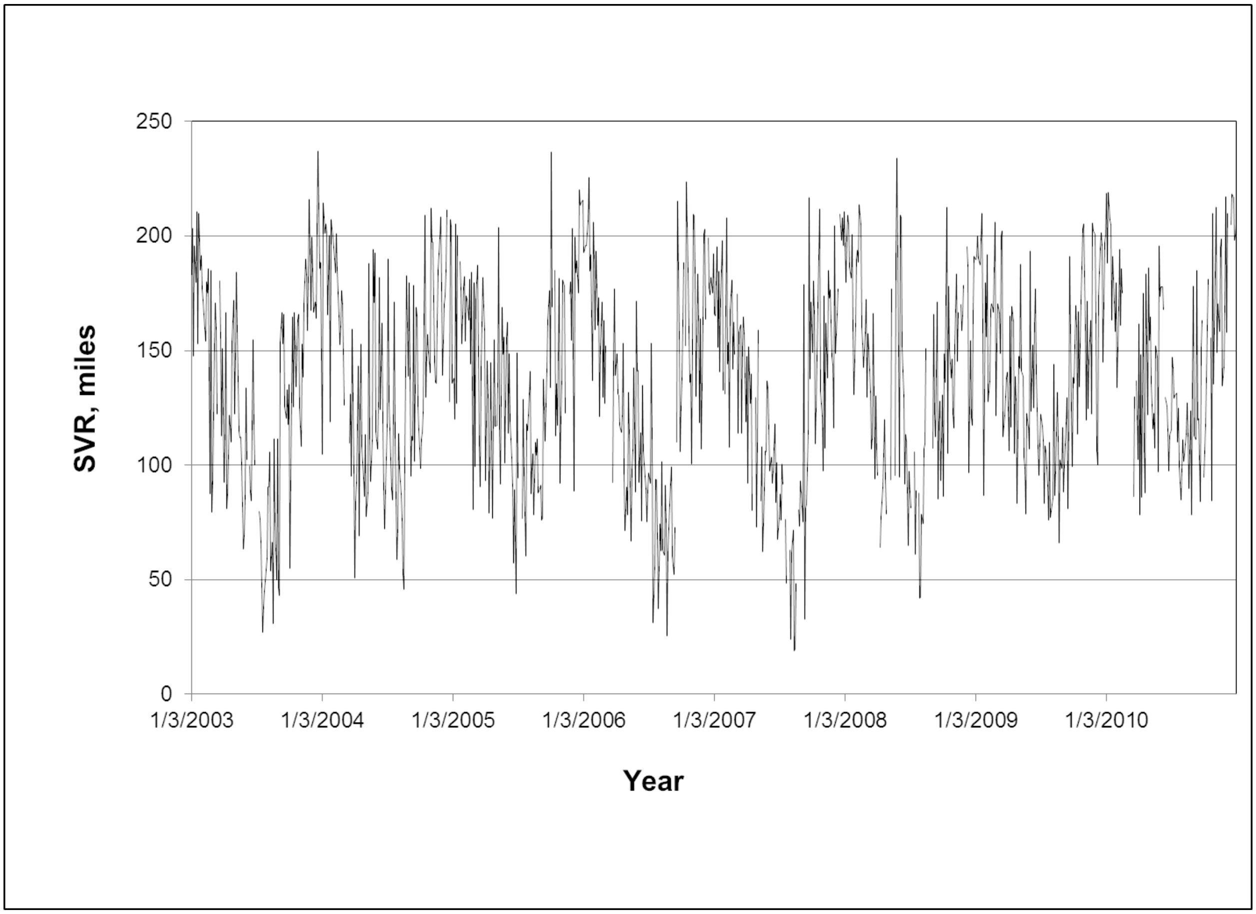
Figure 3.14. Annual Visibility (SVR) for the Cloud Peak IMPROVE Site



Source: IMPROVE 2013

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR standard visual range

Figure 3.15. Weekly Visibility (SVR) for the Thunder Basin IMPROVE Site

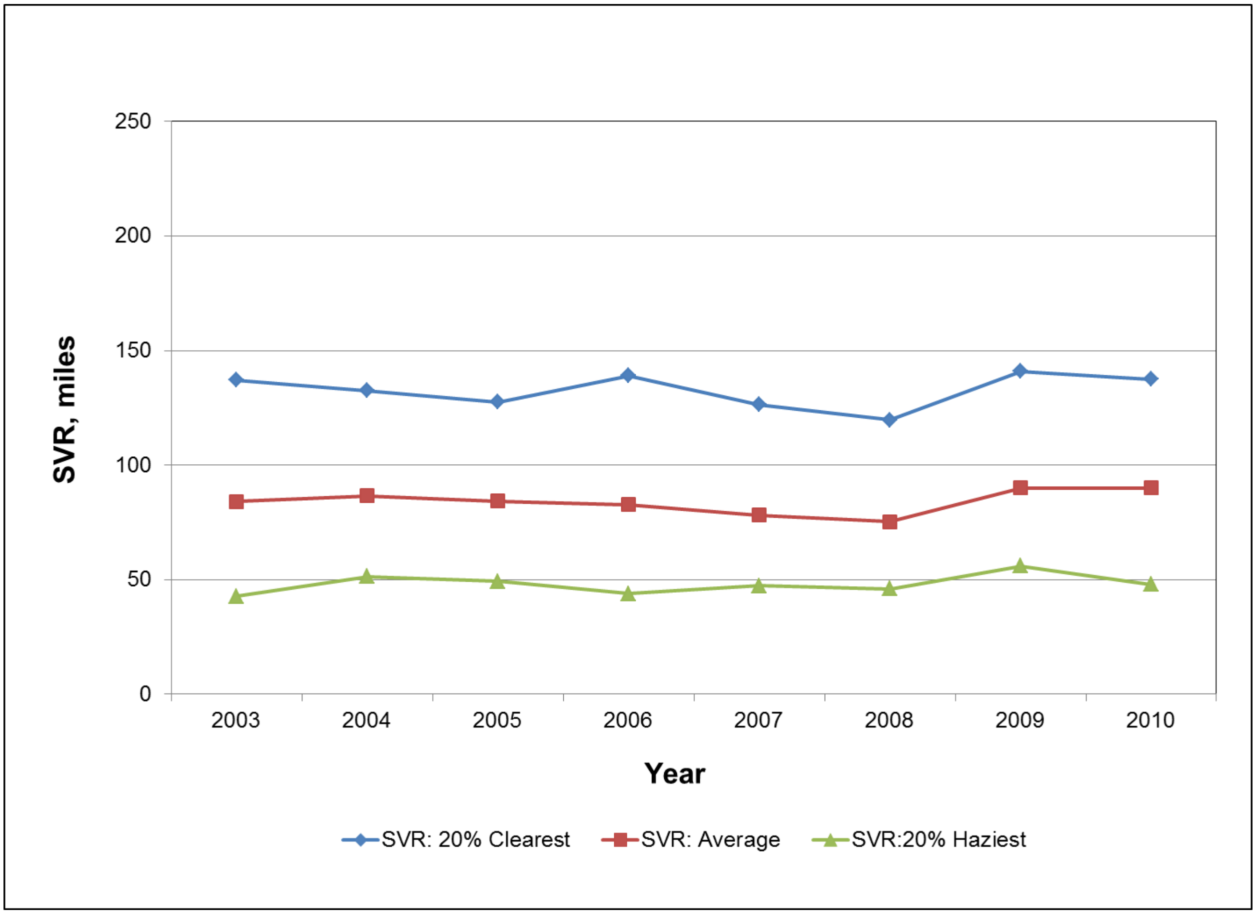


Source: IMPROVE 2013

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR standard visual range

Figure 3.16. Weekly Visibility (SVR) for the Cloud Peak IMPROVE Site

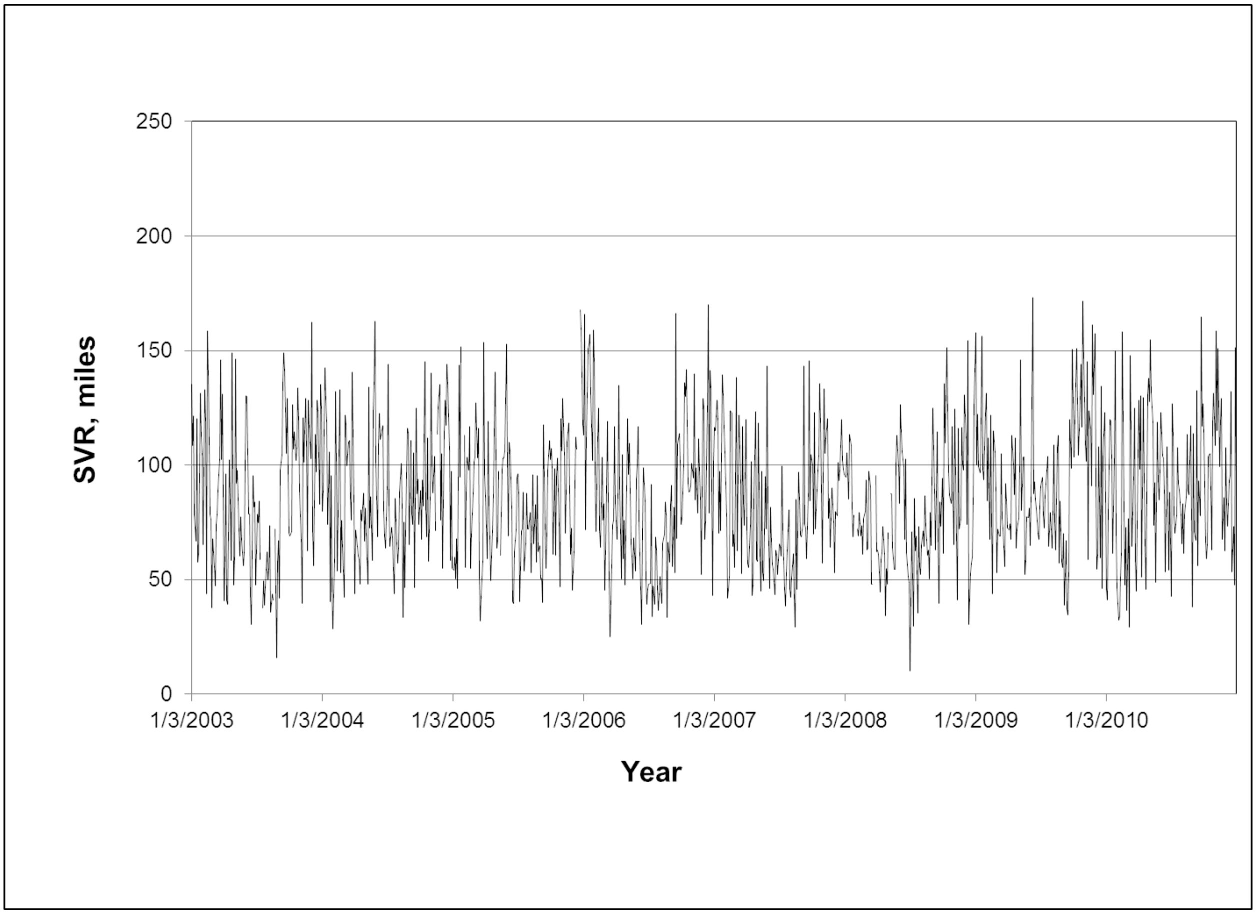
In addition to visibility measurements in the Buffalo planning area, Figure 3.17, “Annual Visibility (SVR) for the Badlands National Park IMPROVE Site” (p. 216) presents SVR visibility estimates for the Badlands National Park site located east of the planning area for the period 2003 to 2010, and Figure 3.18, “Weekly Visibility (SVR) for the Badlands IMPROVE Site” (p. 217) presents weekly visibility estimates for the Badlands National Park site east of the planning area for this same period. The visibility estimates for the Badlands site are lower than those for the Thunder Basin and Cloud Peak sites, but there is no discernible trend in visibility during this period at the Badlands monitor.



Source: IMPROVE 2013

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR standard visual range

Figure 3.17. Annual Visibility (SVR) for the Badlands National Park IMPROVE Site



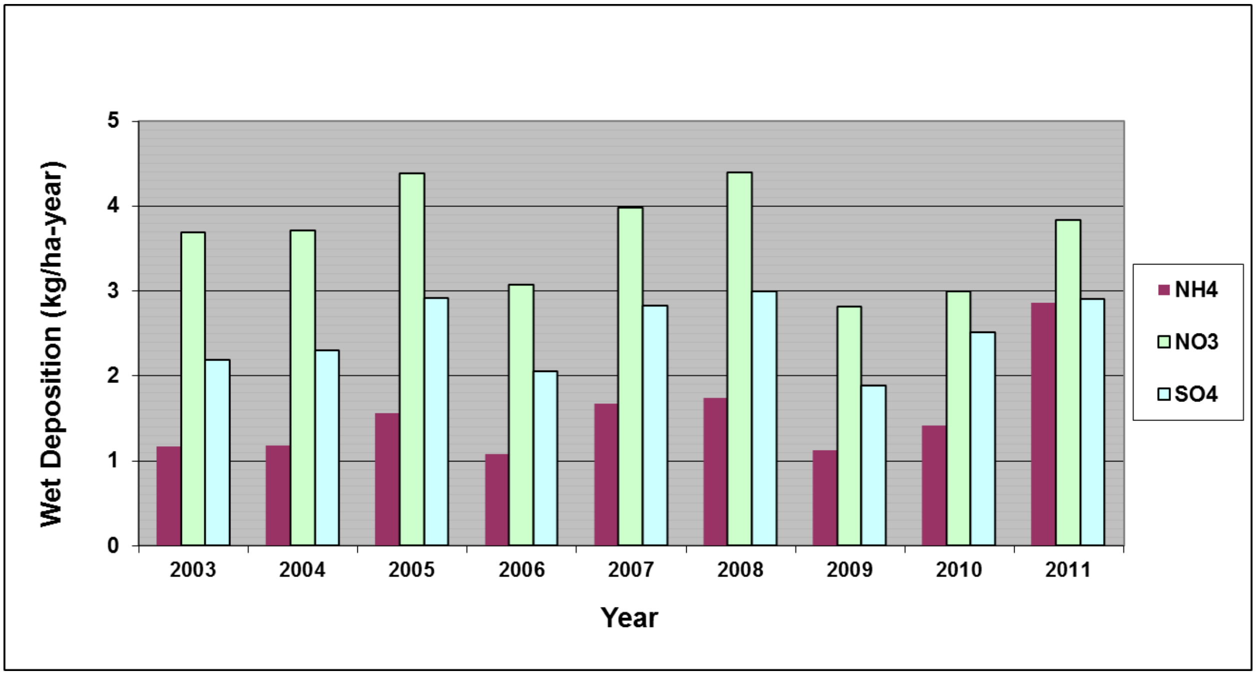
Source: IMPROVE 2009

IMPROVE Interagency Monitoring of Protected Visual Environments
SVR standard visual range

Figure 3.18. Weekly Visibility (SVR) for the Badlands IMPROVE Site

Atmospheric Deposition

There are no NADP or CASTNet/WARMS stations in the planning area, but wet deposition measurements are available for the Newcastle NADP monitor located just east of the area. Figure 3.19, "Mean Annual Wet Deposition (kilogram per hectare per year) – Newcastle, Wyoming NADP Site" (p. 218) presents mean annual wet deposition for NH_4, NO_3, and SO_4, for the period 2003 to 2011. There are no discernible long-term trends in these measurements over this period. Wet nitrogen deposition (of NH_4 and NO_3) is exceeding the current LOCs at the Newcastle monitor for this period, and wet sulfur deposition does not exceed the LOC at this site during this period.



Source: National Atmospheric Deposition Program 2013

kg/ha-year kilograms per hectare-year
NADP National Acid Deposition Program
NH_4 ammonium
NO_3 nitrate
SO_4 sulfate

Figure 3.19. Mean Annual Wet Deposition (kilogram per hectare per year) – Newcastle, Wyoming NADP Site

Hazardous Air Pollutants

Existing sources of HAPs, criteria pollutants, and greenhouse gases in the planning area include fossil fuel combustion that emits HAPs, and oil, gas, and coal development operations that emit VOCs, NO_x,; and hydrogen sulfide (H_2S). In addition, large fires are a source of HAPs emissions. The growth in resource development and accompanying increases in emissions from these types of sources will depend on a number of external factors that make it difficult to estimate actual trends in these pollutants in the planning area.

Climate Change

In 2001, the Intergovernmental Panel on Climate Change (IPCC) pointed out that by 2100, global average surface temperatures would increase 2.5 to 10.4 °F above 1990 levels (Intergovernmental Panel on Climate Change 2007). The National Academy of Sciences (National Academy of Sciences 2006) has confirmed these findings, but also indicated that there are uncertainties regarding how climate change could affect different regions. Computer model forecasts indicate that increases in temperature will not be evenly or equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during summer months, and increases in daily minimum temperatures would be more likely than increases in daily maximum temperatures.

The lack of scientific tools designed to predict climate change at regional or local scales limits the ability to quantify potential future impacts. However, potential impacts to air quality due to climate change are likely to be varied. There are several activities (oil, gas, and coal development; large fires; livestock grazing; and recreation using combustion engines) in the planning area that could generate greenhouse gas emissions (CO_2 and CH_4).

To address the potential adverse consequences of climate change, the EPA has undertaken a number of regulatory initiatives in recent years to reduce greenhouse gas emissions. This started in 2009 with a finding under the CAA identifying the key constituent gases that threaten public health and welfare and contribute to climate change. An initiative was developed for mobile sources by setting engine and fuel standards to cut greenhouse gases and fuel use for new motor vehicles, and the implementation of a renewable fuel standard aimed at decreasing oil imports and reducing greenhouse gases. Another initiative addresses stationary sources to limit greenhouse gases for power plants and other large industrial facilities. The EPA also initiated a national greenhouse gas emissions reporting program for large emitters. Most recently (2012), EPA finalized regulations to reduce pollution from the oil and natural gas industry which is expected to result in substantial reductions in VOC emissions, air toxics, and methane, an important greenhouse gas. These actions, initiatives, and regulations will impact activities in the planning area, especially those related to oil and natural gas development, in an overall effort to balance growth in resource development with continued reductions in key greenhouse gas emissions.

Summary of Air Quality Trends

Available air quality data for recent years for a number of criteria pollutants examined for various monitors in and near the Buffalo planning area do not show any major upward or downward trends over the period of record. Concentrations of $PM_{2.5}$ and the fourth highest 8-hour average ozone concentration are consistent year to year, without any discernible trends. Although trends were not explicitly calculated for SO_2, SO_4, NO_3, and NH_4, the data do not indicate any major trends for the 9-year period examined for the Buffalo and Sheridan sites. The visibility data collected at the Cloud Peak and Thunder Basin sites show very good to excellent visibility, even for the 20% haziest days, with a very slight degradation observed at the Cloud Peak monitor during the last few years of the 8-year period of record. The data collected at the Badlands National Park IMPROVE site show generally lower estimates of visibility range compared to Cloud Peak and Thunder Basin, with no distinct trend in visibility range during the period 2003 to 2010. Wet-deposition data for NH_4, NO_3, and SO_4, for the Newcastle NADP site east of the planning area also show no distinct trend in deposition over the 2003 to 2011 period examined in this analysis.

3.1.1.6. Key Features

Key features for air quality are CAA mandatory Class I areas near the planning area and Class II areas in and near the planning area, including Cloud Peak Wilderness, Bighorn National Forest, Thunder Basin National Grassland, and Black Hills National Forest. Sensitive lakes or lakes sensitive to deposition of acidic atmospheric chemical species in the planning area would be found primarily in the Cloud Peak Wilderness of the Bighorn National Forest. An examination of the most recently available data indicates that the planning area is currently in attainment of all applicable national and State of Wyoming ambient air quality standards.

3.1.2. Geological Resources

3.1.2.1. Regional Context

Most of the Buffalo planning area occurs in the Wyoming portion of the Powder River Basin. The Powder River Basin is bordered to the west by the Big Horn Mountains, to the south by the Casper Arch, Laramie Range and the Hartville Uplift, and to the east by the Black Hills. The Powder River Basin is an asymmetrical syncline with an axis that trends in a general northwesterly direction, and extends from northeastern Wyoming north into southeastern Montana. The Powder River Basin formed through a combination of structural deformation and infilling. Thick sedimentary deposits, which include some of the largest known deposits of coal in the world, overlie Precambrian-age crystalline basement rock in the Powder River Basin; the deepest sedimentary rocks are found along the basin axis (close and approximately parallel to the Big Horn Mountains) and could be more than 18,000 feet thick (Tryhorn 1987). Numerous areas of geological beauty and interest occur in the planning area, including the Red Wall (tilted red sandstone exposed in the southern Big Horns), cave and karst-formations (areas of limestone and dolomite in the southern Big Horns), the Pumpkin Buttes (several largish relatively-flat butte-like erosional remnants near the Powder River), Dry Creek Petrified Tree Environmental Education Area (EEA) (area containing exposed logs and trunk portions of petrified trees), and numerous scoria hills (small butte-like to ridge-like erosional remnants capped by reddish clinker). Refer to the Mineral Occurrence and Development Potential Report (BLM 2009c) for more detailed geological information for the Buffalo planning area.

3.1.2.2. Indicators

None of the geological features occurring on public lands in the Buffalo planning area are considered unique enough to be under special management or conservation measures. However, caves will be managed under cave management plans, as discussed in *Cave and Karst Resources*. The Dry Creek Petrified Tree EEA area is a unique feature, and is under special management due to its special paleontological value, as discussed in *Paleontological Resources*. Coal is not a unique occurrence, however the very large amount of coal present in the Powder River Basin is fairly unique (see *Leasable Minerals – Coal* for more information). Crude oil and natural gas are similarly not unique, but the occurrence of the large volumes of natural gas in much of the coal in the Powder River Basin is fairly unique (see *Leasable Minerals – Fluids* for more information).

As there are no key geological features in the planning area, there are no factors that relate their changing condition. However, mass wasting (i.e., rock falls, landslides, slumps, etc.) and other erosional processes can alter external topography and some landforms in the planning area, and coal seam fires often occur in the Powder River Basin (see *Health and Safety*). The remaining geological resources in the planning area are minerals (see *Mineral Resources* and the individual mineral resource categories for information regarding indicators for the mineral resources). Mineral resources currently being developed in the planning area include coal, crude oil, natural gas, bentonite, uranium, aggregate (sand and gravel), clinker (porcellanite; locally called "scoria" due to its sometimes resembling that volcanic rock), moss rock, and stone. Other minerals are known to occur in the planning area (e.g., gypsum, geothermal resources, rare earth elements [REEs], and many others), however these have not been economically feasible to develop. Based on economic forecasts, that situation is not expected to change during the planning period (see *Mineral Resources*).

3.1.2.3. Current Condition

The minerals currently being explored for and developed in the planning area are coal, crude oil, natural gas, bentonite, uranium, sand, gravel, clinker (porcellanite; locally called "scoria"), and stone. See *Mineral Resources* for more information on these minerals. Coal, oil, and natural gas are extremely important mineral commodities in the Powder River Basin; extraction of these minerals and ranching are the biggest income-producing industries in the planning area (see *Social and Economic Resources*). Over 80% of all coal mined on federal lands in the United States comes from the Buffalo planning area. See also *Leasable Minerals – Coal* and *Leasable Minerals – Fluids* for more information regarding these resources. Table 3.5, "Some Important Mineral-bearing Formations in the Buffalo Planning Area" (p. 222) lists some of the most important mineral-bearing rock and rock strata in the planning area (generally listed from youngest to oldest, and from least to greatest depth) (Love et al. 1993).

Table 3.5. Some Important Mineral-bearing Formations in the Buffalo Planning Area

Strata Name	Geological Age	Description
Alluvium (sand and gravel deposits)	Quaternary	Sand and gravel eroded from Paleozoic- through Precambrian-aged rocks in the Big Horn Mountains is found in terrace deposits scattered across much of the surface of the planning area. See *Salable Minerals*.
Clinker (Porcellanite; locally called "Scoria")		Numerous areas of reddish, relatively resistant clinker (porcellanite; called "scoria" locally) occur across the planning area, often as outcrops capping hills and ridges. Clinker forms when the rock and sediment overlying a burning coal seam become baked by the heat being produced. Clinker's sometimes melted and vesicular (bubbly-looking) texture can make it hard to distinguish from true scoria (a volcanic rock), hence its local nickname. See *Salable Minerals*.
White River Formation	Oligocene	Only a few outcrops of this formation occur in the planning area; these cap the Pumpkin Buttes. Known to contain important fossils and has a high Potential Fossil Yield Classification. See *Paleontological Resources*.
Wasatch Formation	Eocene	Approximately 45% of the surface outcrops in the planning area. Contains numerous coal seams of varying thickness, quality, and areal extent. Natural gas often forms within these coals (coal-bed natural gas, or CBNG), and CBNG can be found almost everywhere in the Powder River Basin where coal is found. See also *Leasable Minerals – Coal* and *Leasable Minerals – Fluids*. Contains numerous areas of clinker, often as outcrops capping hills and ridges. See *Salable Minerals*. Contains sandstone beds and lenses that can have "roll-front" deposits of uranium; these formed where dissolved uranium carrying along by groundwater solidified, usually where it contacted carbon-rich areas in the sandstones. See *Locatable Minerals*. Contains much of the petrified wood found in the Powder River Basin, including that in the Dry Creek Petrified Tree EEA (see *Paleontological Resources)*.

Strata Name	Geological Age	Description
Fort Union Formation	Paleocene	Approximately 30% of the surface outcrops in the planning area. Like the Wasatch Formation, also contains numerous coal seams of varying thickness, quality, and areal extent, which also often contain CBNG. Almost 40% of U.S. coal currently mined comes from the Wyodak-Anderson coal zone. See *Leasable Minerals – Coal* and *Leasable Minerals – Fluids*. Clinker occurs in numerous areas, mostly where coal seams became exposed along the Powder River Basin margins and burned; for example, the Rochelle Hills east of Gillette and Wright formed by natural burning of the Wyodak-Anderson coal zone. See *Salable Minerals*.
Fox Hills Sandstone	Upper Cretaceous	This sandstone varies in thickness and quality throughout the Powder River Basin, and serves as the major fresh-water aquifer in the planning area. For this reason, it is protected during activities that could adversely affect it, such as oil and gas development. See *Water Resources*, and *Leasable Minerals – Fluids*.
Frontier Formation and underlying Mowry Shale	Upper Cretaceous	The Clay Spur Bentonite bed occurring near the contact between these two formations is the main source of bentonite mined in the planning area; thinner beds in the Frontier Formation are also mined. See *Locatable Minerals*. The lower portion of the Mowry Shale contains oil. See *Leasable Minerals – Fluids*.
Gypsum Spring Formation	Jurassic	Contains numerous gypsum beds of varying thickness, quality, and areal extent. See *Locatable Minerals*.
Parkman Sandstone	Upper Cretaceous	These formations are the most prolific and most widespread crude oil-producing formations in the Powder River Basin; they can also yield natural gas. Other formations also yield oil and gas in the Powder River Basin, but the pools within those formations tend to be more localized. See *Leasable Minerals – Fluids*.
Sussex Sandstone		
Shannon Sandstone		
Muddy Sandstone	Lower Cretaceous	
Dakota and Lakota Sandstones		
Minnelusa/ Tensleep Sandstone	Pennsylvanian	

Source: Love et al. 1993

CBNG Coalbed Natural Gas
EEA Environmental Education Area

Although there is some potential for geothermal energy development in the planning area, current knowledge of this resource leads to the belief that it is not, and may never be, economically viable for most current commercial uses due to the relatively low temperatures measured even at relatively great depths (120 °F or 49 °C at over 8,000 feet near the western Powder River Basin margin, to 185 °F or 85 °C at over 12,000 feet near the Powder River Basin axis [WOGCC 2010]). The relatively great thickness of the sedimentary rocks in the Powder River Basin (possibly up to 18,000 feet [Tryhorn 1987]) and the non-volcanic/non-igneous formation history of the Big Horn Mountains, leads to the relatively low bottom-hole temperatures seen in deep oil/gas wells. Although some commercial uses of low-temperature geothermal energy (up to 194 °F or 90 °C) can be economically viable (BLM 2008d), the depths are likely too deep to make development economically feasible (BLM 2008d; Williams et al. 2008; DOE 2006; National Oceanic and Atmospheric Administration 1983). No commercial low-temperature geothermal energy projects are known to exist in the planning area, although many of these types of projects could be incompatible with current land uses. Most knowledge of this resource comes from bottom-hole temperatures (the temperature measured at the deepest point in a wellbore) in oil and gas wells, and very little geothermal exploration has been performed in the planning area

(Williams et al. 2008; DOE 2006; National Oceanic and Atmospheric Administration 1983). Only with more exploration will the extent of this resource in the planning area, and the likelihood for its development, become more fully understood. To date, no lands in the planning area have been nominated for competitive geothermal leasing, nor have any leases or nominations for leases for geothermal energy been received for the planning area. See *Leasable Minerals – Fluids*.

There is some potential for REEs in the planning area, although current knowledge of this resource is limited to mostly unconfirmed reports of occurrences and geochemical analyses. See *Locatable Minerals* for more information.

To date, no carbon dioxide sequestration projects (also called CO_2 Capture and Storage [CCS]) exist on public lands in the planning area, nor have any proposals been received. However, due to climate change-related legislation, sequestration (long-term storage) of this greenhouse gas is being studied and researched. The geological formations currently identified as being most suitable for CO_2 sequestration are unmineable coal seams, depleted oil and gas reservoirs, and saline geological formations (Burruss et al. 2009; Intergovernmental Panel on Climate Change 2005). There are numerous oil and gas reservoirs and unmineable coal seams, and several saline geological formations, in the Powder River Basin. Wyoming and several other U.S. states are thought to be ideal for CO_2 sequestration projects: they have relatively high potential CO_2 storage capacity in "suitable" formations (relatively common formations in these states) and they have relatively "quiet" geological settings (tendency to have fewer earthquakes/earth movements and in lower magnitudes) (Intergovernmental Panel on Climate Change 2005). The current direction regarding CO_2 sequestration projects on public lands is that they would be handled as rights-of-way (ROW); see *Rights-of-Way and Corridors*.

There are a number of geological and other natural hazards in the planning area, including coal seam fires, ground subsidence, H_2S gas, abandoned mine lands (AMLs), and landslides. See *Health and Safety* for more information.

3.1.2.4. Trends

As discussed above, the geological resources managed in the Buffalo planning area consist of mineral resources. See *Mineral Resources* for information regarding trends for the various individual mineral resources.

As the development of alternative energy sources increases in the United States and worldwide, it could become economically viable to develop the low-temperature geothermal resources in the Powder River Basin in the future, even at the relatively great depths at which it occurs. If geothermal resources in the planning area become a development target in the future, the Buffalo Field Office would likely administer this resource in a manner similar to that of other field offices with existing geothermal energy programs (see *Leasable Minerals – Fluids*).

Almost the entire Powder River Basin could be targeted for CO_2 sequestration projects. The geological formations currently identified as being most suitable for CO_2 sequestration are abundant throughout the entire Powder River Basin. Although no CO_2 sequestration projects have been proposed for public lands in the planning area, it is quite likely that such projects may be proposed in the future.

The geological and natural hazards in the Buffalo planning area, and their changing conditions and trends, are addressed in *Health and Safety*.

3.1.2.5. Key Features

As discussed under Regional Context and Indicators, above, key geological features are discussed in other sections such as *Paleontological Resources* (Dry Creek Petrified Tree EEA) and *Cave and Karst* (caves and karst areas). Mineral-related features, such as coal, oil and gas, bentonite, uranium, aggregate (sand and gravel), and clinker (porcellanite; locally called “scoria”) are discussed in *Mineral Resources*, and the individual mineral sections under that heading (*Leasable Minerals – Coal*, *Leasable Minerals – Fluids*, *Locatable Minerals*, and *Salable Minerals*).

3.1.3. Soil

Information in the following soils section is based on the best available science which is currently available through the Natural Resource Conservation Service (NRCS) soil survey data (NRCS 2011a). On a regional level, general State Soils Geographic Database (STATSGO2) was reviewed and incorporated as appropriate. Smaller scale information Soil Survey Geographic Database (SSURGO) was also reviewed and incorporated as appropriate into document sections below. Additional information is reviewed, verified and incorporated on a project specific basis as needed due to the high variability of soils and soils issues throughout the planning area but is not included in this document. On specific soil management issues, additional information from NRCS, BLM, academic and regional expert sources was incorporated where needed.

3.1.3.1. Regional Context

The planning area’s soils are grouped geographically by Land Resource Regions (LRR) and Major Land Resource Areas (MLRA) for descriptive purposes. LRRs are geographically associated MLRAs which approximate broad agricultural market regions. Identification of these large areas is important in statewide agricultural planning and has value in interstate, regional, and national planning. The MLRA concept guides the development of cooperative soil survey work on BLM-administered lands. The planning area is located predominately in LRR G (Western Great Plains and Irrigated Region) and E (Rocky Mountain Range and Forest Region). Dominant MLRAs within these Land Resource Regions are 58B (Northern Rolling High Plains Southern Part) with soils that are dominantly shallow to very deep, generally well drained, and loamy or clayey. They formed in alluvium, eolian sediments, colluvium, or residuum on fans, terraces, hills, and plateaus. MLRA 43B (Central Rocky Mountains) are comprised of soils that are skeletal and are medium to coarse textured. These soils formed in colluvium, residuum, and glacial till on mountain sideslopes and ridges.

3.1.3.2. Indicators

Indicators are soil characteristics that are sensitive to change in the environment that reflect changes in soil quality. Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries to do the following: sustain plant and animal productivity; maintain or enhance water and air quality; and support human health and habitation. Soil quality is evaluated relative to a standard or reference condition that represents the full capacity of a soil to function for a specific use.

Soil quality reflects both inherent and dynamic properties. Inherent soil properties form over thousands of years with soil-forming processes and change very little as a result of management practices. Many inherent properties are described by soil surveys and can be used to develop local interpretations for suitable uses and limitations. Dynamic soil properties are readily affected by management practices and natural disturbances over relatively short time scales. By linking biological, physical, and chemical properties of soil, all of the components and interactions of a soil system are viewed together. The selection of method(s) to assess soil quality will depend on the intended use of the information, the time and resources available, the ease with which the information can be obtained, and any regional, local, or site-specific considerations.

The primary indicators for soil resources currently used in the Buffalo Field Office are soil/stability, hydrologic function, and biotic Integrity. These indicators are part BLM's Land Health Assessment (LHA), and are used to assess soil health in the context of BLM's Standard and Guidelines (S&Gs) requirements. Reclamation success is evaluated through the Erosion Condition Classification System (Clark 1980) which quantifies site stability. The Wyoming Reclamation Policy also provides guidance to help maintain healthy productive soils, while maintaining an effective multiple-use land management program.

The Soil, Water, and Air program provides technical assistance and policy guidance in implementing land health standards. Maintaining and improving land health is the responsibility of the agency. BLM's resource management activities should be designed to limit soil degradation and loss and to repair and/or restore those areas that have already been damaged. BLM Manual Section 7100.06(c), it is BLM policy to use soils and ecological site description information in conducting land health assessments to help achieve aquatic, riparian, and upland health on BLM-administered land (H-7100-1 Soil Inventory, Monitoring, and Management Handbook Final Draft September 21, 2010 [BLM 2010a]).

3.1.3.3. Current Condition

Soils in the planning area are diverse; great differences in soil properties can occur within short distances. The distribution and occurrence of soils is dependent on a number of factors including the interaction of relief (slope), parent material, living organisms, climate, and time. These variables create complex and diverse soil patterns that influence the use and management of the soil resource.

Generally, there is not a direct demand for soil resources from public lands in the planning area. Primarily demands placed on soil resources are surface-disturbing activities associated with the development of other resources. The most important regional or national demand placed on soils in the planning area results from the development of mineral resources. Locally other actions that affect soils include a variety of surface uses that loosen topsoil and remove vegetation or other ground cover, such as grazing and browsing by animals, off-highway vehicle (OHV) use, development of trails and campgrounds, ROW, fire-suppression activities, and the use of prescribed fire.

General soils information for the planning area was obtained from the United States General Soils Map (NRCS 2006) which is designed primarily for regional, multi-state, river basin, state, and multi-county resource planning, management and monitoring. STATSGO2 data provides a general overview of soils distribution and occurrence in the planning area, and is not suitable for site-specific evaluations. Detailed information is available from the SSURGO Database for the individual soil surveys within the planning area. These individual soil surveys include, Soil Survey of Southern Campbell County (WY605), Soil Survey of Northern Campbell County (WY705), Soil Survey of Southern Johnson County (WY619), Soil Survey of Northern Johnson County (WY719) (preliminary data), Soil Survey of Sheridan County (WY 633) and the Soil Survey of

Bighorn National Forest (WY 650). These soil surveys were performed by NRCS according to National Cooperative Soil Survey standards, policies and procedures, and were conducted at the second and third order of detail. For site-specific analysis, onsite soil investigations and detailed soils information should be considered in all resource management decisions.

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding (NRCS No Date).

Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Examples of such crops are citrus, tree nuts, olives, cranberries, fruit, and vegetables (NRCS No Date).

3.1.3.4. Trends

Most soils in the area are capable of producing forage for wildlife and livestock, maintaining infiltration and runoff protective of watershed condition, and recovering from impacts associated with surface-disturbing activities. Major soil resource concerns in this region are surface disturbance associated with the development of other resources. The collective amount of surface disturbance or vegetative manipulation that can be supported by soils in the planning area has not been determined. Soils in the planning area are highly variable, and depending on specific site conditions, soil losses of one to five tons per acre per year (based on NRCS information) could occur on soils in the planning area without a substantial reduction in soil productivity. Surface-disturbing activities have the potential to increase annual soil loss to levels much greater than the amount at which the quality of a soil as a medium for plant growth can be maintained.

3.1.3.5. Key Features

Key features are areas that require special management practices to prevent adverse impacts to soil quality. Soil quality is analogous to water and air quality, but there are no laws or standards to protect soil quality. However, water and air quality can be impacted by soil quality. For instance, wind-blown soil particles degrade air quality, while excessive sediment in water bodies degrades water quality (BLM 2010a). Key features identified in the planning area include soils with poor reclamation suitability, highly erodible soils, limited reclamation potential areas, and soils on steep slopes.

Successful reclamation efforts are critical in maintaining a multiple use land management program. Reclamation suitability is the inherent ability of the soil to recover from impacts; often referred to as soil resilience. Suitability factors include physical and chemical properties to consider for successful reclamation. These limiting features include clayey and sandy textures, drought conditions, shallow depth to bedrock, stones and cobbles, erosion potential, low organic matter content, alkalinity and pH, salinity, and sodium content. Sometimes the soil limitations may require additional mitigation to meet reclamation goals and objectives. Soils identified as having poor reclamation suitability potentially occupy 58% of BLM surface and 40% of the federal mineral estate (See Map 5).

There are areas in the planning area that are identified as having highly erodible soils. Highly erodible soils are those soils which are susceptible to wind or water erosion in either their natural or disturbed state. (See Map 3.) For purposes of this analysis, elements used to determine highly erodible soils are slope, surface soil K factor, and wind erodibility group. However, it should be noted that K factors are also assigned to soil horizons deeper in the profile; at the project specific level, it may be useful to evaluate these deeper K factors. The K factor (K_f for fine earth fraction or K_w for whole soil) indicates the susceptibility of a soil to sheet and rill erosion by water. This is based on percentage of silt, sand, organic matter, surface soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Severe water erosion hazards for each Soil Mapping Unit (SMU) were identified using the k-factor and representative slope percentage (Rv Slope) assigned to each SMU. These values are available in the soil characteristic tables in the soil surveys, published by the NRCS. SMUs with an erosion index (kw × Rv Slope) greater than or equal to 7.0, are considered to be susceptible to water erosion. Severe wind erosion hazards for each SMU were identified by using the wind erodibility group (WEG) assigned to each SMU. WEG, is a numerical value indicating the susceptibility of soil to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture, frozen soil layers, slope and other factors may also influence erosion. There are nine groupings: 1, 2, 3, 4, 4L, 5, 6, 7, and 8. The lower the number, the greater the risk of wind erosion. These grouping are also available in the soil characteristic tables in the Soil Surveys, published by the NRCS. SMUs with a WEG of 2 and less are considered susceptible to wind erosion. Potentially 25% of BLM surface and 17.5% of the federal mineral estate have surface properties identified as being highly erodible (wind or water).

Limited reclamation potential areas (LRP), according to the BLM statewide reclamation policy, are defined as areas possessing unique landscape characteristics (e.g., sensitive geologic formations, extremely limiting soil conditions, biological soil crusts, badlands, rock-outcrops, etc.) that often make reclamation success impractical and/or unrealistic due to physical, biological, and/or chemical challenges. Some LRP areas are currently identified as miscellaneous areas including, but not limited to, badlands, rock outcrop, and gullied lands in the current SSURGO soils data. Other potential LRP areas may include areas susceptible to mass movement, areas with biologic soil crusts, and very shallow ecological sites or other areas identified through onsite investigation as having properties that make meeting all the requirement of reclamation unrealistic or impossible. Areas that have additive key features that make successful reclamation impractical or impossible may also be considered LRP areas. Current analysis indicates potentially 8% of BLM surface and 4% federal mineral estate contain LRP areas, map shows areas that potentially contain a percentage of LRP areas (see Map 5).

Soils on steep slopes are another key feature in the planning area (Map 4). Slope gradient is the difference in elevation between two points, expressed as a percentage of the difference between those points. Slope is a component in determining water erosion potential, slumping, mass wasting, and landslide potential. Slope impacts total disturbance calculations and potential cut and fill depths for surface-disturbing activities.

Key features will be identified using NRCS soil survey SSURGO data and onsite evaluations. Criteria used to determine soil sensitivity to surface uses would continually be adapted as conditions change or new information or technology becomes available that enhances the understanding of these susceptible soils.

3.1.4. Water Resources

3.1.4.1. Regional Context

The planning area is comprised of six major watersheds that collect and convey surface water out of the region. These are the Belle Fourche River, Little Bighorn River, Cheyenne River, Little Missouri River, Powder River, and Tongue River. These rivers are fed by numerous smaller drainages, most of which are ephemeral. Groundwater also plays an important role in the planning area. Numerous groundwater aquifers are present in the planning area at a wide range of depths, in varying geologic conditions, and water quality levels. Regulatory issues regarding water in the planning area are largely handled by the Wyoming Department of Environmental Quality and the Wyoming State Engineers Office.

3.1.4.2. Indicators

This section identifies indicators of the condition of water resources in the planning area and the sources of those indicators.

Natural processes and human actions influence the chemical, physical, and biological characteristics of water. Water quality varies from place to place, seasonally, and according to the kind of substrate through which the water moves. Indicators of water quality include, but are not limited to:

- Chemical characteristics (e.g., pH, conductivity, dissolved oxygen)
- Physical characteristics (e.g., sediment, temperature, color)
- Biological characteristics (e.g., macro- and micro-invertebrates, fecal coliform, and plant and animal species)

Indicators of watershed health include:

- Channel morphology characteristics (e.g., aggradation, degradation, and bank failure)
- Watershed conditions (e.g., soil erosion and vegetation condition)

Water resource monitoring in the planning area is designed and managed to provide the BLM with baseline information on the conditions of water quantity and quality, and changes to those conditions that could be attributable to natural processes or BLM management activities. Monitoring activities include the collection of surface and subsurface hydrological data, and climatological data. As part of the hydrologic assessments, the BLM collects data on surface water and groundwater quality, stream channel morphology, streamflow, and groundwater elevation at a variety of locations. Climatological data that is collected includes precipitation, temperature, wind intensity and direction, solar radiation, barometric pressure, relative humidity, and soil moisture. Water sources historically used by livestock and wildlife are also monitored for quality and quantity to assess changes to those resources.

Additionally, the BLM monitors some stream channels and riparian areas for Proper Functioning Condition (PFC) (see the *Vegetation – Riparian/Wetland Resources* section of this chapter), which are indirect indicators of water quality and watershed health. The BLM uses other survey methodologies, such as Multiple Indicator Monitoring (MIM) (Burton et al. 2008), to provide further detail for the assessment of stream corridor conditions.

3.1.4.3. Current Condition

This section characterizes surface water and groundwater resources and describes water use and current water management practices in the planning area.

Water management within the boundaries of the planning area is primarily the responsibility of the Wyoming State Engineer's Office (WSEO), which administers all of the water resources of the state, and the Wyoming DEQ, which administers water discharges. The BLM is responsible for the management of federal lands and minerals in a manner that maintains or enhances water quality and quantity for other uses. Data collection, resource monitoring, and analysis is performed to evaluate impacts or investigate special concerns related to CBNG development. Other agencies involved in managing and regulating the water resources of the area are the U.S. Army Corps of Engineers, the EPA, the U.S. Fish and Wildlife Service (USFWS), and Wyoming Game and Fish Department (WGFD).

Surface Water

Information in this section includes:

- Watersheds within the planning area, and a map showing the major streams and lakes in the planning area
- The major tributary waterways in the planning area and their flow conditions
- A description of surface water quality and quantity and a reference to the Wyoming DEQ requirements for water quality in Class 1 and 2 waterway segments
- Identification of watersheds in the planning area with Class 1 or 2 waterways
- A discussion on surface discharge of water (e.g., produced water from CBNG development), including a list of permitted outfalls if available, and the regulations associated with discharged waters
- A discussion of watershed conditions affecting the effective life (and associated costs) of water development projects, such as reservoirs and spring developments
- Historic and present resources and resource uses that could affect surface water quality
- A description of the state 303(d) list and total maximum daily load allocation of pollutants
- Waterways in the planning area on the Wyoming DEQ 303(d) list of water bodies with impaired water quality

The planning area is comprised of two distinct hydrologic regions: the mountainous region where snowmelt is the dominant influence on streamflow, and the plains region where runoff from convective storms is the dominant factor controlling peak flow rates (Lowham 1988). Mean annual precipitation in this semi-arid region ranges from about 10 inches to more than 15 inches in the plains region of the planning area, and up to 30 inches in the mountainous region (Lowry et al. 1986). Approximately half of the annual precipitation falls in April, May, and June (Rankl and Lowry 1990). Average annual snowfall ranges from less than 30 inches to more than 100 inches. Annual lake evaporation averages approximately 40 inches, greatly exceeding annual precipitation (Whitehead 1996).

The planning area is within portions of six major watersheds: the Belle Fourche, the Little Bighorn, the Cheyenne, the Little Missouri, the Powder, and the Tongue.

The Powder River is the largest watershed in the planning area, and drains more than half (65%) of the planning area. Other drainages in the planning area include the Little Bighorn and Tongue River, which drain the northwestern area (14%); the Belle Fourche River, which drains the eastern area (11%); the Cheyenne River, which drains the southeastern area (6%); the Little Powder River, which drains most of the northeast area (3%); and the Little Missouri River, which drains a strip along the eastern part of the planning area adjacent to the state line (1%). The Powder River, along with several other larger streams in the planning area, including Clear Creek, Crazy Woman Creek, the Little Bighorn River, and the Tongue River, have headwaters in the Big Horn Mountains. The U.S. Geological Survey (USGS) classifies these as perennial streams. Except for the main stem of the Powder River, which courses through the middle of the Powder River Basin, these streams generally flow with clear water, and generally carry little suspended sediment. The southern Big Horn Mountains contain approximately 50 miles of perennial streams on public land. All of the perennial streams in the planning area and their associated vegetation communities represent important fish and wildlife habitat on both public and private land. Intermittent streams that have enough seasonal flow to support growth of riparian vegetation also provide important wildlife habitat.

Most of the streams and tributaries with headwaters in the plains region are ephemeral, flowing only in direct response to precipitation events or snowmelt. These channels are formed in fine-grained, unconsolidated Tertiary sedimentary units or Quaternary basin fill. This material is easily eroded, especially in areas where vegetation is relatively sparse. These conditions often result in high sediment delivery to the Powder River.

The Wyoming DEQ, in compliance with the federal Clean Water Act (CWA), requires that water quality be maintained or improved for outstanding (Class 1) and most of high-quality (Class 2) waters (Wyoming DEQ 2007). Table 3.6, "Surface Water Classes and Uses in Wyoming" (p. 231) describes water quality classes. The Wyoming DEQ manages all surface discharges in the state through the Wyoming Pollutant Discharge Elimination System (WYPDES) permit process. Water produced and discharged in association with any industrial activity, including oil and gas development, must be permitted through the WYPDES process. WYPDES permits typically require compliance with specific water quality effluent standards that vary by stream class, and are periodically reviewed and revised for existing uses. Water discharged on the surface must be suitable for existing or planned uses, such as agriculture and livestock, and cannot result in a violation of water quality standards in the receiving stream. The Wyoming DEQ defines stream classes and water quality standards (Wyoming DEQ 2002), and a list of classified segments is maintained and available from the Wyoming DEQ.

Table 3.6. Surface Water Classes and Uses in Wyoming

Class 1, Outstanding Waters	No further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices.
Class 2, Fisheries and Drinking Water	Support fish or drinking water supplies or where those uses are attainable. Class 2 waters may be perennial, intermittent, or ephemeral.
Class 3, Aquatic Life Other than Fish	Intermittent, ephemeral, or isolated waters and waters that, because of natural habitat conditions, do not support or have the potential to support fish populations or spawning, or certain perennial waters that lack the natural water quality to support fish (e.g., geothermal areas).

Class 4, Agriculture, Industry, Recreation and Wildlife	Aquatic life uses are not attainable. Uses include recreation, wildlife, industry, agriculture, and scenic value.
Source: Wyoming DEQ 2007	

As required by Clean Water Act Section 404, the Wyoming DEQ identifies waters which do not support designated uses. The water bodies that do not support designated uses, either due to watershed degradation or because of exceedances of water quality criteria, are on the state 303(d) list and 305(b) report, which are updated every two years. The 2008 303(d) list includes 642.3 miles of impaired or “not-supporting” streams and 37.9 miles of “threatened” streams within the boundaries of the planning area (Wyoming DEQ 2008). To address the issues causing the impairments, the Wyoming DEQ is developing Total Maximum Daily Load (TMDL) allocations for impaired water bodies throughout the state. When the Wyoming DEQ develops TMDLs for the water bodies in the planning area, the BLM will cooperate with those efforts. In the meantime, the BLM is developing measures to manage and monitor the streams on the 303(d) list that flow through land it administers.

A considerable amount of water produced as a result of CBNG activities is discharged into streams in the Powder River Basin. This water was projected in the Powder River Basin FEIS to gradually increase flow rates in the various streams as CBNG development escalated. Actual water volumes discharged into Wyoming streams has been substantially less than predicted. Table 3.7, “ Coalbed Natural Gas Water Production Summary in the Buffalo Planning Area” (p. 232) lists some these values through 2008.

Table 3.7. Coalbed Natural Gas Water Production Summary in the Buffalo Planning Area

Watershed	Predicted Cumulative Total Water Production (2002 through 2008) (acre-feet)	Actual Cumulative Total Water Production (2002 through 2008) (acre-feet)	Percent of Actual vs. Predicted Water Production as of 2008
Antelope Creek	114,097	27,304	23.9
Clear Creek	153,242	8,486	5.5
Crazy Woman Creek	125,742	1,573	1.3
Little Powder River	142,752	60,608	42.5
Middle Powder River	74,276	36,939	49.7
Upper Belle Fourche	530,949	111,602	21.0
Cheyenne River	54,166	43,207	79.8
Upper Powder River	1,047,521	212,522	20.3
Upper Tongue River	132,952	70,558	53.1
Total	2,375,697	572,799	24.1
Source: WOGCC 2009			

Groundwater

Information in this section includes:

- The geological features in which groundwater resources occur
- The major regional aquifers in the planning area and estimates of recoverable groundwater
- Uses of groundwater in the planning area
- Groundwater quality conditions related to total dissolved solids (TDS) and trends in the planning area, and areas that are highly vulnerable to groundwater contamination

Aquifers

Aquifers in the planning area are generally of two types: Quaternary alluvial aquifers and the Lower Tertiary aquifers of the Northern Great Plains Aquifer System. Numerous seeps and springs also occur in the planning area in association with steep topographic relief, discontinuous stratigraphy, and scoria outcrops. Most groundwater utilization in the planning area occurs in the Powder River Basin, where considerable groundwater resources are available.

Quaternary alluvial aquifers occur in stream valley alluvium, generally along rivers and larger drainage channels in the Powder River Basin. These alluvial aquifers are composed of unconsolidated deposits of silt, sand, and gravel and occur as floodplains, stream terraces, and alluvial fans (Whitehead 1996). Coarser alluvial deposits occur in valleys of the Belle Fourche, Cheyenne, Powder, and Little Powder Rivers. The thickest and coarsest-grained alluvium occurs near the Big Horn Mountains along the western margin of the Powder River Basin, where saturated horizons are thick and high water yields are possible.

The Northern Great Plains Aquifer System is an extensive sequence of aquifers and confining units arranged in a stack of layers that can be locally discontinuous, but functions regionally as a single aquifer system. This system includes the lower Tertiary aquifers exposed at the surface in the Powder River Basin, and underlying, deeply buried regional aquifers stacked with intervening confining layers. The Lower Tertiary Aquifer System consists of semi-consolidated to consolidated Paleocene to Oligocene sediments and sandstones, and coal seams in the Paleocene Fort Union Formation and the Eocene Wasatch Formation (Whitehead 1996). Stratigraphically from youngest to oldest, the Lower Tertiary Aquifer System consists of the Wasatch aquifers, the Fort Union aquifers, the Lebo confining layer, and the Tullock aquifer.

Scoria, which plays an important role as an aquifer in the storage and flow of water in the Powder River Basin, has been formed from these geologic formations in locations where sediments have been altered in place by the spontaneous combustion of coalbeds (Coates and Heffern 1999; Heffern and Coates 1999). Rainfall and snowmelt infiltrate rapidly in scoria exposure areas. The stored water is discharged slowly to springs, streams, and aquifers, which helps maintain flow in perennial streams during dry periods (Coates and Heffern 1999; Heffern and Coates 1999). Scoria outcrops cover about 350 square miles of the planning area and are concentrated along the eastern boundary of the planning area in the Rochelle Hills; within the Powder River Breaks in the northern portion of the planning area; within the Tongue River Breaks north of Sheridan; within the Lake DeSmet area north of Buffalo; and within the Felix coal outcrop area west of Gillette and northeast of Wright (Coates and Heffern 1999; Heffern and Coates 1999).

Groundwater Use

Groundwater in the planning area is used for a variety of purposes, including domestic, municipal, industrial, and agricultural uses. Domestic and livestock wells are usually low yield (1 to 25 gallons per minute). Water for domestic and livestock use is generally found at depths less than 1,000 feet. Many wells in the Powder River Basin have sufficient pressure to flow without being pumped. Occasionally, flowing springs also provide domestic and livestock water sources in the area. Industrial water wells are used primarily for secondary recovery of petroleum.

Water Quality

Government agencies, the oil and gas industry, and mining industries in the planning area have collected data on existing groundwater quality conditions during the development of water resources, the drilling of wells for oil and gas extraction, and in mining and pre-mining activities. The most water resource monitoring in the planning area is performed in connection with CBNG development. The primary BLM program consists of a series of deep and shallow groundwater wells monitored on a quarterly schedule. In addition, the USGS maintains gauging stations on all major drainages in the planning area. Water quantity is generally the focus, but water quality is also monitored at several surface water and groundwater stations.

Groundwater quality depends on the source geologic formation or aquifer and varies throughout the planning area. Lowry et al. (1986) reported TDS concentrations for alluvial aquifers varying from 106 to 6,610 milligrams per liter, and averaging 2,128 milligrams per liter for 38 samples. Water from surficial deposits that contains less than 600 milligrams per liter TDS can be divided into two chemical types – a calcium magnesium carbonate type and a calcium magnesium sulfate type (Rankl and Lowry 1990; Bartos and Ogle 2002). TDS concentrations greater than 600 milligrams per liter generally are due to increased values for sodium and sulfate (Rankl and Lowry 1990). There is no one dominant water type (Hodson et al. 1973).

Water in alluvium near the Big Horn Mountains and the Black Hills is of better quality than water in alluvium in the central part of the Powder River Basin. Water in the Powder River alluvial deposits is dominated by sodium, calcium, magnesium, and sulfate ions, while the water in the underlying bedrock is dominated by sodium and bicarbonate ions (Bartos and Ogle 2002). Water in alluvium in the southwest part of the Powder River Basin and along the Powder River is generally of poorer quality than water in alluvium elsewhere in the Powder River Basin, thus limiting its use as a water supply. Water quality in the Wasatch aquifer is quite variable. Wasatch aquifers have TDS concentrations varying from 227 to 8,200 milligrams per liter, and averaging 1,298 milligrams per liter, with sodium sulfate and sodium bicarbonate as the dominant water types (Hodson et al. 1973; Lowry et al. 1986). Water quality in the Fort Union aquifer has been shown to have TDS concentrations ranging from about 200 to more than 3,000 milligrams per liter, generally ranging between 500 and 1,500 milligrams per liter, with sodium bicarbonate and sodium sulfate as the dominant water types (Hodson et al. 1973).

TDS concentrations in scoria varies widely from under 500 milligrams per liter to more than 7,000 milligrams per liter. Water in scoria from recharge areas near the burn line tends to be a calcium sulfate type, and water in scoria from discharge areas tends to be a sodium bicarbonate type similar to water in coal seams. Ash residue at the base of the scoria might contribute to high TDS concentrations (Coates and Heffern 1999).

Mineral developers who produce water from aquifers with high salt and heavy metal concentrations as part of their extraction process must handle this water in prescribed ways, such as containment in evaporation ponds, treatment, reinjection into a formation containing water of lower quality, or direct surface discharge. In all cases where the water is to be discharged into waters of the state, the operator must obtain a WYPDES permit from the Wyoming DEQ. The BLM manages the impacts of federal actions on watersheds and water resources.

Surface Water and Groundwater Quantity and Use

Waters in the planning area are used primarily for agricultural, mining, municipal, and industrial purposes. There is also water-based recreation in the planning area, but consumptive use for these purposes is low. Agricultural use consists primarily of livestock watering and irrigation. By far the greatest source of withdrawals is irrigation use primarily for forage production for the livestock industry. Table 3.8, “Water Use Summary in the Buffalo Planning Area” (p. 235) provides an approximate breakdown of annual water use in the planning area in 2000.

Table 3.8. Water Use Summary in the Buffalo Planning Area

Type of Water Usage	Current Use (acre-feet per year)		
	Groundwater	Surface Water	Total
Domestic (2000 Census)	3,125	7,326	10,451
Commercial	n/a	n/a	n/a
Industrial	426	258	684
Livestock	n/a	n/a	n/a
Irrigation (withdrawal)	1,815	425,986	427,801
Mining (including coalbed natural gas)[1]	66,821	15,201	82,023
Totals	72,187	44,8771	520,959

Source: USGS 2000

[1] Water extracted during coalbed natural gas production accounts for most of the volume. This water might be used for other purposes after extraction.
n/a Not Applicable

Active water wells are permitted through the WSEO in the three counties of the planning area. Table 3.9, "Uses of Active Well Permits by County" (p. 235) summarizes the uses and active permits in each county.

Table 3.9. Uses of Active Well Permits by County

County	Use	Number of Active Permits
Campbell	Coalbed natural gas	22,543
	Domestic	1,025
	Domestic, stock	893
	Industrial	404
	Irrigation	23
	Miscellaneous	1,322
	Monitoring	3,172
	Municipal	30
	Stock	2,846
	Test Well	43
Johnson	Coalbed natural gas	6,034
	Domestic	2,205
	Domestic, stock	407
	Industrial	50
	Irrigation	32
	Miscellaneous	210
	Monitoring	783
	Municipal	4
	Stock	2,020
	Test Well	12
Sheridan	Coalbed natural gas	5,895
	Domestic	2,693
	Domestic, stock	664
	Industrial	3
	Irrigation	26
	Miscellaneous	289
	Monitoring	962
	Municipal	5
	Stock	1,097
	Test Well	12

Source: Wyoming State Engineers Office 2001

Table 3.10, “WSEO-Permitted Non-CBNG Water Wells in the Planning Area by Aquifer” (p. 236) summarizes permitted, non-CBNG groundwater wells by aquifer in the planning area. Aquifer formation names were associated with completed wells by Applied Hydrology and Associates (BLM 2003c) wherever well depths were available from WSEO data.

Table 3.10. WSEO-Permitted Non-CBNG Water Wells in the Planning Area by Aquifer

Well Type	Aquifer Formation Name	Number of Wells
Domestic	Fort Union	2,218
	Wasatch	3,173
	Unknown	1,192
	Total	6,583
Municipal	Fort Union	50
	Wasatch	42
	Unknown	43
	Total	135
Irrigation	Fort Union	45
	Wasatch	92
	Unknown	117
	Total	254
Other	Fort Union	6,771
	Wasatch	9,115
	Unknown	4,088
	Total	19,974
Total		26,946

Sources: BLM 2003c; Wyoming State Engineers Office 2001

CBNG Coalbed Natural Gas
WSEO Wyoming State Engineer's Office

3.1.4.4. Trends

This section describes the degree and direction of change between present and past water conditions, and explains the direction of the trend from the current desired condition based on the indicators previously described. In addition, this section describes the drivers or agents of change for water in the planning area. When describing trends, this section notes whether the trend is based on quantitative or qualitative information.

Surface Water and Groundwater Quantity and Use

Increased discharge of CBNG produced water into ephemeral streams enhances the survival and spread of invasive species, such as tamarisk. Due to increased water availability, stands of tamarisk have become established in several Powder River Basin drainages where it would not normally survive. Once established, tamarisk establish deep tap roots that can consume considerable quantities of water, thereby reducing water availability to more desirable species. Disposal of produced water in Powder River Basin channels might be limited to a period of 10 to 15 years, but can increase erosion and promote sediment delivery to trunk streams during this time.

CBNG development is depleting groundwater resources in some coal zones in the Powder River Basin. In most cases, other groundwater zones are available to replace those lost, but the quantity of the usable resource is being reduced considerably. Monitoring by the BLM and data compiled by the Wyoming State Geologic Society has shown aquifer drawdowns in excess of 600 feet as of 2006 (Wyoming State Geological Survey 2010).

Surface Water and Groundwater Quality

Infiltration of CBNG produced water from holding ponds has shown the potential to impact shallow groundwater. However, the more important cases are limited to few locations in relation to the thousands of reservoirs in the planning area. The Wyoming DEQ regulates these impacts through a groundwater monitoring program tailored for CBNG development. Similarly, many reservoirs holding CBNG water have leaked water to downstream channels. As water infiltrates through the reservoir bottom and migrates through the bedrock, there is the potential to dissolve and transport undesirable constituents, such as selenium and sulfate, that might then appear as surface water at down-gradient seepage zones. CBNG water discharged into ephemeral drainages has caused substantial erosion in several cases, and has transported sediment to main-stem channels. Likewise, miles of new roads and drilling pads associated with CBNG development have increased erosion and sediment transport in relation to background rates. Spills of drilling fluids and fluids produced as a result of oil and gas development have increased as development has accelerated, and have the potential to impact surface water and groundwater systems.

Rice et al. (2002) summarize the major dissolved-ion chemistry of CBM produced water from the Fort Union coal zone within the Powder River Basin based on results for 83 groundwater samples from wells completed in the Fort Union coal zone. The locations of wells completed in Fort Union coal zones that were sampled are shown in Rice et al. (2002). Most wells sampled are located in Campbell County. Most wells sampled in Campbell County are located southwest of Gillette. One cluster of wells sampled is located north of Sheridan. A few wells sampled are located in Johnson County. Water produced from the Fort Union Formation is exclusively sodium bicarbonate-type water. The concentrations of iron and manganese in some samples analyzed exceed the secondary maximum contaminant levels for drinking water established by EPA. Concentrations of iron and manganese are relatively high because of their higher solubility as Fe^{+2} and Mn^{+2} in anoxic (without oxygen) waters. Concentrations of barium are relatively high, likely as a result of the low concentrations of sulfate. In waters that contain sulfate, barium has low solubility and forms a precipitate (barium sulfate).

Rice et al. (2002) summarize the dissolved trace-element chemistry of CBM produced water from the Fort Union coal zone within the Powder River Basin based on results for groundwater samples from wells completed in the Fort Union coal zone. All concentrations of trace elements are uniformly low and are below the primary and secondary maximum contaminant levels for drinking water established by EPA. There are no noticeable basinwide trends in concentrations of trace elements.

The median value for TDS (838 mg/L) reported by Rice et al. (2002) exceeds the secondary maximum contaminant level for drinking water established by EPA. The TDS values reported by Rice et al. (2002) indicate that the concentration of TDS increases from south to north and from east to west in the Powder River Basin. This increase generally results from an increase in sodium and bicarbonate within the water.

The SAR, a calculation of the abundance of sodium relative to calcium and magnesium in water, also increases toward the west and north, with the lowest values reported near and south of Gillette (Rice et al. 2002). The SAR values range from 5 to 69 and the median value is 8.8 (Rice et al. 2002).

The BLM has summarized and modeled SAR and specific conductance (EC) values for CBM produced water by sub-watershed (BLM 2003c). The SAR and EC are physical properties of water that indicate the relative suitability of water for beneficial and state-designated uses. In the near-surface environment, water that contains high SAR values would cause an exchange of ions in clay minerals within soils. In this case, calcium (Ca^{+2}) and magnesium (Mg^{+2}) are exchanged for sodium (Na^{+}), creating sodium-rich clays with an increased swelling potential and greatly reduced permeability (Rice et al. 2002). The EC is a measure of the capacity of the water to conduct an electric current and indicates the degree of mineralization of the water (Bartos and Ogle 2002).

Data for samples from 132 wells were compiled for analysis and modeling. Data for 122 wells were provided by the USGS (Rice et al. 2002). Data from seven wells were provided by the BLM, the WDEQ supplied data for two wells, and Williams Production Company provided the results of chemical analysis from one well.

Because of the limited amount of data for the Upper Tongue River, Clear Creek, and Crazy Woman Creek sub-watersheds, it was necessary to estimate one data point in the north-central portion of the basin (T57N R79W). Values for SAR and EC at this data point were calculated by averaging values from the two closest data points. The estimated point was required to permit modeling of data from the widely spaced wells without generating anomalies in the SAR/EC model grid.

Other potential surface and groundwater issues could arise from the development of ISR uranium. Any such development would be under the regulatory authority of the Nuclear Regulatory Commission, and water quality impacts would be under the authority of Wyoming DEQ.

Forecasts

Surface Water and Groundwater Quantity and Use

Groundwater sources are adequate to meet the demand of all current uses on public land (primarily livestock, wildlife, and recreation). CBNG development is affecting groundwater sources in the Powder River Basin. Coal seams are being completely dewatered in some cases, and sandstone aquifers in communication with these zones could also be affected. If a well completed into a coal seam being produced by a nearby CBNG operator is affected, the operator generally is responsible for replacing the well with another groundwater resource. However, there are cases in which wells were affected and the cause could not be defined. Such cases will likely occur in the future. Surface water sources are generally adequate to meet existing uses on public lands. However, natural climatic fluctuations (such as drought) can make marginally adequate sources unreliable. Watershed condition also affects the effective life (and associated costs) of water development projects such as reservoir and spring developments.

The construction of numerous reservoirs in the Powder River Basin could increase the recurrence interval for channel-maintaining flow events, which could affect the fluvial geomorphology of trunk streams or change the nature of riparian vegetation (e.g., cottonwood seedling germination and survival) and general water availability in the dry season.

With increasing demand for water for agriculture, wildlife, and recreation, new and alternative water sources are continually being sought. One such source that has become more prevalent in recent years is the conversion of wells associated with oil and gas development (water supply wells and oil and gas production wells) to water wells. This can be beneficial to resource management on BLM-administered lands in many areas. It is generally a relatively low-cost method of developing new water sources. The negative side of taking over these wells is that the BLM assumes all down-hole liability – that is, if problems arise in the future, the BLM could face a substantial plugging and abandoning or rehabilitation cost. This can be minimized if adequate down-hole construction information is available (or can be supported with geophysical logs or video inspection) and the conversion properly designed and supervised by an experienced geohydrologist or petroleum engineer.

Surface Water and Groundwater Quality

The development and use of other resources (e.g., minerals, range, forestry, and recreation) can affect surface water and groundwater quality. However, water quality can be maintained by prudent resource development and use, and proper application of mitigation measures. Such measures are identified in site-specific management or development plans.

3.1.4.5. Key Features

This section describes the geographic locations, distribution, areas, and types of water-related features that should guide land use allocation or management decisions.

BLM-administered lands in the planning area contain Wyoming DEQ Class 1 outstanding waters. These are waters of the state that are of the highest importance and meet criteria for water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archeological, fish, and wildlife, and have the presence of substantial quantities of developable water and other values of present and future benefit to the people (Wyoming DEQ 2007).

Class 1 waters within the planning area include the main stem of the Middle Fork Powder River through its entire length above the mouth of Buffalo Creek, the main stem of the Tongue River, the North Fork of the Tongue River, and the South Fork of the Tongue River above the USFS boundary. These streams are found at higher-elevation watershed recharge areas and provide perennial streamflow for fisheries, riparian habitat, and downstream water to the public. The BLM manages tracts of land around these waters, including the Middle Fork Recreation Area on the Middle Fork Powder River.

Class 2 waters are those not designated as Class 1 that are known to support fish habitat or drinking water supplies (or where those uses are possible). Class 2 waters that are tributaries of the Powder River include the North Fork Powder River, Clear Creek, and Crazy Woman Creek. Other streams that could have special attributes include tributaries of the Little Powder River, Beartrap Creek; the North, Middle, and South Forks of Crazy Woman Creek; Billy Creek; and Pole Creek. These creeks are ecologically important and have been identified by the State of Wyoming to meet their designated uses. The BLM also manages some smaller tracts along these waters that provide fish habitat. All provide good quality water and riparian habitat for the use of wildlife, recreation, and fisheries.

3.1.5. Cave and Karst Resources

3.1.5.1. Regional Context

The Federal Cave Resources Protection Act of 1988 (16 United States Code [U.S.C.] 4301-4309) Section 3(1) defines a cave as any naturally occurring void, cavity, recess, or system of interconnected passages beneath the surface of the earth or within a cliff or ledge (including any cave resource therein, but not including any mine, tunnel, aqueduct, or other man-made excavation), and is large enough to permit an individual to enter, whether or not the entrance is naturally formed or man made. Ritter et al. (2002) defines karst as “terrain with distinctive landforms and drainage arising from greater rock solubility in natural water than is found elsewhere.” There are millions of acres of cave and karst resources within the Rocky Mountain West. Cave and karst resources provide habitat for common and Endangered species, research potential for numerous scientific disciplines, and challenges for recreationists. Cave and karst resources in the region are generally in good condition. Challenges to resource managers that oversee cave and karst resources vary by planning area and include: mineral exploration and extraction, recreational activity, looting, and vandalism.

3.1.5.2. Indicators

Previously, the Buffalo Field Office did not actively manage the cave and karst resources within its jurisdiction. Nothing is known about the prior condition of these resources and there are no established indicators for cave and karst resources in the planning area.

3.1.5.3. Current Condition

There is substantial karst topography throughout the Big Horn Mountains. However, most of Buffalo planning area karst in the Big Horn Mountains, is concentrated in the southern end of the range. This area extends from the Natrona County line, west to the Washakie County line, and north to Highway 16, east to Crazy Woman Road, and south along the face of the Big Horns to the Natrona County line. This karst region is primarily comprised of Madison and Amsden limestone layers overlying Bighorn dolomite and constitutes about 456,266 acres. In this same area Tensleep, Gallatin, and Deadwood sandstones provide for the formations of rock shelters. To the east of the Big Horn Mountain range, Wasatch sandstone frequently outcrops in the short-grass plains. Rock shelters also occur in this environment. Karst features, caves and rock shelters contain various types of cave-adapted animal and plant life. These formations are also frequently associated with significant cultural resources. There are numerous caves, karst features, and rock shelters in the planning area. BLM specialists developed descriptions of karst lands, primarily based on regional geographic features. Map 7 displays cave and karst formations in the planning area. Files for each cave or sensitive location on BLM surface are being compiled and will be maintained at the Buffalo Field Office.

Cave and karst resources in the planning area are generally in remote and extremely rugged terrain. These areas have limited options for access. Most cave and karst resources are well protected by virtue of their locations. Remote cave and karst resources are at greatest risk from the secondary effects of management decisions. At present, accessing most of the cave and karst resources in the planning area requires a substantial expenditure of time and effort. Generally, only those who are specifically interested in seeking out caves will utilize most of the area's cave and karst resources. These individuals are likely to be aware of Tread Lightly and Leave No Trace principles that will minimize impacts to cave and karst resources. Caves near access roads and recreation areas are the most vulnerable to casual use and vandalism. These caves are often well known and heavily visited. Graffiti, accumulations of trash, and damage to cave resources (e.g., plants, animals, and formations), are all common results of frequent casual use. It is expected that visitation to all cave and karst resources, remote and easily accessible alike, will increase. White-nose syndrome (WNS) has not been detected in the state of Wyoming. WNS is a concern, but is not an immediate threat to cave resources.

The Federal Cave Resource Protection Act of 1988 directs the Secretary of the Interior to prepare and maintain a listing of significant caves. The criteria for listing of significant caves are found at 43 Code of Federal Regulations (CFR) 37.11(c). It has been determined that seven caves on BLM-administered public land in the planning area meet one or more of the significant-cave criteria. Section 5(a) of the Federal Cave Resource Protection Act requires that the location of significant caves be kept confidential to protect these resources from unauthorized use and vandalism.

3.1.5.4. Trends

There are no available quantitative and qualitative trend data for cave resources in the planning area. Given the lack of condition or trend data for caves in the planning area, forecasts for the area's resources are likewise not available. The Buffalo Field Office is now collecting data to enable the successful management of cave and karst resources within its jurisdiction. However, as Wyoming populations grow and more people recreate in the planning area, impacts to cave and karst resources will increase. In addition, given the large amount of karst topography in the planning area, future cave discoveries are very likely. WNS has not yet been detected west of Oklahoma. It is impossible to gauge whether or not caves in the planning area will be affected by WNS, however currently, WNS has not been detected in Wyoming.

3.1.5.5. Key Features

Key features in the planning area are limited to geological formations likely to produce or contain cave and karst resources. These formations are useful for planning purposes as they highlight areas that require careful scrutiny prior to permitting or allowing activities that may impact cave and karst resources.

3.2. Mineral Resources

The federal government classifies minerals into three categories: locatable minerals (uncommon minerals, such as sodium bentonite [also called Wyoming-type bentonite], gypsum, uranium, most metals, and gemstones); leasable minerals (such as crude oil, natural gas, coal, and geothermal energy); and salable minerals (also called mineral materials) (common minerals, such as common varieties of stone, sand, gravel, clinker [locally called "scoria"], and many clays). The location of, exploration on and development of mining claims (and sometimes mill or tunnel sites), the exploration for and leasing of leasable minerals, and the exploration for and disposal of salable minerals on federal lands are authorized by a number of Congressional Acts, and regulated under the CFR. The appropriate sections of the CFR include: for oil and gas: 43 CFR 3100; for geothermal energy: 43 CFR 3200; for coal: 43 CFR 3400; for solid leasables other than coal: 43 CFR 3500; for salables: 43 CFR 3600; and for locatable minerals (mining claim minerals): 43 CFR 3800. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c), or the statutes and regulations themselves, for more information.

The following sections describe the locatable, leasable, and salable minerals that occur in the planning area. Each mineral resource is addressed individually in accordance with BLM Manual 3031, *Energy and Mineral Resource Assessments* (BLM 1985a). Three other reports associated with this RMP provide more in-depth discussions of certain minerals: the *Mineral Occurrence and Development Potential Report* (BLM 2009c), the *Reasonable Foreseeable Development (RFD) Potential for Oil and Gas* (Stilwell et al. 2012), and the *Summary of the Analysis of* *the Management Situation* (AMS) (BLM 2009i). Most of the planning area lies within the Wyoming portion of the Powder River Basin, a major energy development area. It is the largest coal-producing region in the United States. Almost all of this coal is used to generate electricity inside and outside the region. Large quantities of crude oil and natural gas are also produced in the Powder River Basin. The only leasable minerals known to occur in the planning area in economically viable quantities are coal, crude oil, and natural gas. Although geothermal energy exists in the planning area, the known depths at which temperatures that may be useful for commercial application occur are too deep to be economically viable to develop at this time. Other leasable minerals also occur in the planning area, but are also uneconomical to produce (often quantity and/or quality is insufficient for commercial production, and/or the material is prohibitively far from the nearest market area). Locatable minerals occurring in the planning area include bentonite (Wyoming-type sodium-containing bentonite), gypsum, and uranium; of these three, sodium bentonite and uranium are economically viable to develop. Gypsum has not been economically viable to develop to date, and is expected to remain uneconomical well into the future given current technology and market conditions. Other locatable minerals are either not known to occur in the planning area or do not occur in quantities currently economically viable to produce. Salable minerals occurring in the planning area include sand, gravel, clinker (locally called “scoria”), moss rock, and stone (building and decorative). Other salable minerals are either not known to occur in the planning area or do not occur in quantities currently economically viable to produce.

Although development of the various mineral resources in the planning area tends to decrease their overall quantity over time, the quantities of many of these resources remaining after many years of mining and development are still quite plentiful (see the various sections below). In addition, erosion and weathering are not anticipated to affect these resources to a material degree; average erosion rates for the major rock types occurring in the planning area range from 0.74 inch to 3.51 inches per 1,000 years (Ferrier et al. 2007; Allred 2004; Riebe et al. 2001).

Determination of the ownership of the mineral estate (the subsurface under a given parcel of land) can often be fairly simple, but can sometimes be more difficult. Mineral ownership is determined based on the content of patent documents. The owner of the mineral estate also administers the mineral estate, meaning they determine if and how the minerals in that land may be developed. The specific minerals under federal ownership for a given parcel of land are determined by the type of federal mineral ownership. The following abbreviations (and their meanings) are used on U.S. Department of the Interior (DOI) BLM Master Title Plats (MTPs): “All Min” (all minerals), “Coal” (only coal), “Coal OG” (only coal, oil, and gas), “OG” (only oil and gas), and “Coal OG Sod Pot” (only coal, oil, gas, sodium, and potassium). A number of other federal minerals ownership abbreviations are also used on MTPs to denote minerals reserved to the federal government other than through the Homestead Acts (see Appendix A (p. 1569), and the *Mineral Occurrence and Development Potential Report* [BLM 2009c], for more information regarding these acts). Two examples are “All Lsbl Min” (federal government owns only the leasable minerals) and “Min Only 50%” (federal government owns only 50% interest in the minerals). Lands that have no federal mineral ownership have no mineral descriptors on their MTPs. Whether federal mineral estate is administered by the federal agency that administers the federally owned surface depends on the mineral classification. For example, locatable and salable minerals are administered by U.S. Forest Service (USFS) on lands within USFS administrative boundaries (including non-USFS surface), but BLM administers the leasable minerals such as oil and gas for those lands. All federally owned minerals (locatable, leasable, and salable) occurring under private, State of Wyoming, or BLM surface outside USFS administrative boundaries are administered by the BLM.

The acreages listed in Chapter 4 for the minerals resources are acres of federal mineral estate, unless stated otherwise. For all other resources, their acreages are usually acres of BLM surface, unless stated otherwise. Below are listed the federal mineral ownership types for the three mineral classifications in the planning area:

- The total acres of federal locatable minerals resource (federally owned locatable minerals) are lands with federal mineral ownership type “All Min,” and occurring under all surface ownership types (not including USFS-administered lands). These comprise the total acreage in the planning area open to locatable minerals as analyzed in Chapter 4. See *Locatable Minerals* below for more information. Mining claims are valid if they are located correctly and legally on any acreage with mineral ownership type “All Min.”
- The total acres of federal salable minerals resource are lands with federal mineral ownership type “All Min,” and occurring under any surface ownership type (not including USFS-administered lands). These lands comprise the total federal salable minerals resource as analyzed in Chapter 4.
- For leasable minerals, a number of federal mineral ownership types could apply, depending on the particular mineral:
  - The total acres of federal coal resource are lands with federal mineral ownership types “All Min,” “Coal,” “Coal OG,” and “Coal OG Sod Pot.”
  - The total acres of federal oil and gas resource are lands with federal mineral ownership types “All Min,” “Coal OG,” “OG,” and “Coal OG Sod Pot.”
  - The total acres of federal geothermal energy resource are lands with federal mineral ownership type “All Min.”
  - For all other leasable minerals, it depends on the specific mineral. For example, the total acres of federal phosphate resource are lands with federal mineral ownership type “All Min,” while the total acres of federal sodium resource includes those with ownership types “All Min,” and “Coal OG Sod Pot.” As another example, minerals that would ordinarily be locatable are in one specific circumstance leasable; this only occurs on acquired lands. Therefore, the total acres of federal leasable uranium resource are only those (acquired) lands with federal mineral ownership type “All Lsbl Min.”

For the analyses summarized in the minerals sections of Chapter 4, the various acreages listed as impacted or potentially impacted by the various management actions indicated are the acreages with the federally owned mineral type(s) appropriate to that particular mineral(s). For example, the federal coal acres (acres of federal coal resource) impacted are acres of federally owned coal (lands with federal mineral ownership types “All Min,” “Coal,” “Coal OG,” and “Coal OG Sod Pot”) in the areas impacted or potentially impacted by the management decision(s) on behalf of another resource. The percent of federal coal acres impacted is calculated by dividing the total acres of federal coal by the acres of impacted federal coal, and then multiplying by 100. Chapter 4 presents other types of acres or percents under other resources, and these are labeled accordingly. However, federal coal acreage is somewhat different from other minerals in that there are areas currently designated as “high development potential for coal.” These areas are carefully selected, based on a number of parameters (coal screening process); see *Leasable Minerals – Coal*. This means that the federal coal acreage within the high coal development potential areas is that which is most likely to be developed for coal during the life of the RMP. The federal coal acreage outside these areas would very likely not be development targets during the life of the RMP, depending on the specific alternative selected in this RMP regarding coal management. Therefore, although another resource's management action may impact a certain number of the total acres of federal coal estate, it may not impact those acres of federal coal estate that are likely to be developed during the life of the RMP. See *Leasable Minerals – Coal* for more information regarding the high development potential areas for coal, and specific anticipated impacts to the federal coal acreage.

3.2.1. Locatable Minerals

3.2.1.1. Regional Context

The primary locatable minerals developed in Wyoming are sodium bentonite (also called Wyoming-type bentonite), gypsum, uranium, and decorative landscape rock. The locatable minerals occurring in commercially viable quantities in the planning area are sodium bentonite, gypsum, and uranium (see Map 9 for the locations these minerals are most likely to be found in the planning area). Sodium bentonite and uranium are currently economic to produce; gypsum is not, nor is it likely to be during the life of the RMP. Other locatable minerals are known to exist in the planning area, but are currently uneconomic to produce. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information.

3.2.1.2. Indicators

Indicators used to describe resource condition and assess the status of the locatable minerals resources in the planning area include currently known quantities (both actual known and estimated quantities), historic and forecasted demand, and historic and forecasted production. See the subsections below for more information by mineral. Often there is a production time lag; it takes time for mines to increase production to meet an increase in demand, or for planned mines to come into production. Therefore, previously stockpiled amounts can be quickly depleted when demand increases quickly.

Changes in prices (actual and forecasted) over time for these resources also can be indicators. However, because a change in commodity price often drives changes in supply and/or demand for that commodity, the changes in production and/or demand over time often closely either mirror or parallel price changes. Price changes are usually more volatile, occurring much more quickly and frequently, than changes in demand or production, and can occur for numerous reasons possibly unrelated to the commodity itself. Therefore, price changes are not addressed here.

Additionally, changes in price and/or demand for a particular commodity (either increases or decreases) can lead to additional materials being introduced into the market as suppliers attempt to remain economically solvent. This factor, the introduction of substitute materials into the marketplace, often makes the accurate predictions of demand, supply, and price for individual minerals extremely difficult, both in the short and long term. Development and/or use of substitute materials is not as common for energy minerals like uranium (as well as coal, oil, and natural gas), due to the sometimes vast and capital-intensive infrastructure needed to utilize these minerals as energy sources. However, it can be common for industrial minerals, even those with very special properties such that of sodium bentonite; new materials are being tested and developed continually in efforts to find cheaper, more abundant materials with similar properties.

The levels of mineral exploration and development activities, and the areas where they take place, are integrally linked to supply and demand for these commodities. This often involves local, national, and international economics and politics, and is therefore difficult to predict on the scale of the planning area. Note also that societal, political, and economic priorities, decisions, and events can affect locatable minerals activities through increases or decreases in exploration and/or development activities, and where they occur. Conversely, increases or decreases in locatable minerals activities could impact societal, political, and economic priorities, decisions, and events. As it is difficult to accurately predict future trends in mineral demand and production on the scale of the planning area, only the indicators quantity, demand, and production, and the trends they might reveal, are discussed here, and in relatively general terms.

3.2.1.3. Current Condition

Locatable minerals (both metallic and nonmetallic) are those that are open to mining claim location under the provisions of the *General Mining Law of 1872*, as amended. This and other laws and regulations (such as 43 CFR 3800) outline the requirements for mining claim location and maintenance, and obtaining a patent on a mining claim. Note that provision for obtaining mining claim patents has been under a moratorium by Congress since 1994, although the backlog of pending decisions from that date is still being processed. See for more information the *Mineral Occurrence and Development Potential Report* (BLM 2009c), or contact the BLM field office closest to the area desired for locating a mining claim.

Locatable minerals known to exist in the planning area include sodium bentonite (also called Wyoming-type) and uranium, both economic to produce. The only other locatable mineral known to exist in the planning area in commercial quantities (quantities large enough to support a commercial mining operation) is gypsum. Gypsum however, has not historically been, nor is currently, economic to produce; this is not likely to change during the planning period. Other locatable minerals are known to exist in the planning area, including gold, silver, platinum, copper, and many other metals, as well as gemstones, and REEs. Like gypsum, none of these are currently economic to produce, and are not likely to be during the planning period. Unlike gypsum, these minerals are not known to exist in commercial quantities. Limestone deposits occur in the southern Big Horns (see *Cave and Karst Resources*), and some metallurgical-grade limestone (95% or greater purity) is suspected to exist in this area. Economically viable production is unlikely for this commodity, however, due to the remoteness of the area, and long distance to markets. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information. There are several mostly unconfirmed reports of the occurrence of REEs in the planning area, in southwestern Johnson County and along the border between the Buffalo Field Office (Johnson and Sheridan counties) and the Cody and Worland Field Offices (Bighorn and Washakie counties) (King and Hausel 1991).

Unless formally withdrawn from (closed to) mineral entry, all federal lands in the planning area (including federally administered surface/federal minerals and split estate), are open to the location of mining claims and mill and tunnel sites, as well as exploration for and development of locatable minerals; this includes other "operations" as defined at 43 CFR 3809.5. To explore for and develop locatable minerals (excluding casual use), either a Notice or a Mine Plan of Operations (POO) is required, depending on the amount of surface disturbance and type of activity; see 43 CFR 3809.10. More than one locatable mineral may be located on a mining claim (see Table 3.11, "Active Mining Claims in the Buffalo Planning Area" (p. 248)) explored for and/or developed on the same land at the same time; therefore, the plural, "locatable minerals," is used. Mining/reclamation plans and reclamation bonding requirements are developed in cooperation with the State of Wyoming DEQ LQD; these items are also required and mutually developed by the NRC for uranium development projects. All locatable minerals projects are reviewed to ensure that no undue or unnecessary degradation would occur, and for compliance with bonding policy for reclamation after cessation of project activities.

Areas withdrawn from locatable mineral entry are not available to the location of mining claims and exploration and development of locatable minerals. Section 103 of FLPMA defines the term "withdrawal" to mean "withholding an area of Federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area or reserving the area for a particular public purpose or program."

Section 204 of FLPMA identifies the process for a land use plan to withdraw areas from locatable mineral entry. The Secretary of the Interior is authorized to withdraw lands from mining laws following certain procedures. These vary depending on whether the proposed withdrawal is less than 5,000 acres or greater than 5,000 acres. The primary difference between the two processes is that a withdrawal greater than 5,000 acres requires the preparation of an extensive report to support the withdrawal, including a specialist's analysis of the area's mineral potential, and notification to Congress of the proposed withdrawal. Congress may then choose to terminate the withdrawal by concurrent resolution.

Withdrawals created after FLPMA's enactment in 1976 cannot be for a period longer than 20 years and must be completed within 2 years following the land use plan decision to pursue the withdrawal. The process of requesting or applying for the Secretary of the Interior to withdraw the lands is started by the identification of lands in the RMP for which to pursue a withdrawal. Following this RMP decision, a mineral potential report must be prepared to include all of the information required by FLPMA, 43 CFR 2310, and BLM Manual 3060. The withdrawal request, including the mineral potential report, is submitted to the Secretary, who then determines if it should be sent to Congress or denied.

The RMP is not the decision that withdraws the lands from the mining laws. Rather, the RMP identifies lands for which a locatable mineral withdrawal will be pursued. It is possible that withdrawals identified in the record of decision (ROD) will not ultimately be withdrawn. For purposes of analysis, however, lands proposed for withdrawal under the different alternatives are identified in this document as "withdrawn" and the different process for a withdrawal of less than 5,000 acres is not separately discussed. It is assumed that areas identified to pursue withdrawal under the different alternatives will actually result in withdrawal occurring. In addition, unless a withdrawal of public domain land specifically provides otherwise, the land withdrawn is presumed to be available for oil and gas leasing on a discretionary basis as specified in the Mineral Leasing Act of 1920 (as amended), and any other applicable land use decisions.

The following three areas in the planning area are not open to mineral location, as they have been withdrawn from mineral entry through formal Congressional actions:

- Amsden Creek Big Game Winter Range – This area was originally named the Tongue River Deer Refuge and Winter Pasture. Withdrawn are 523 acres of BLM-administered surface/federal mineral lands in northwestern Sheridan County. The Amsden Creek Wildlife Habitat Management Area (WHMA) overlaps this area, and is administered by the WGFD.
- Kerns Big Game Winter Range – Also called the Kerns WHMA, this area was originally named the Sheridan County Elk Winter Pasture. Withdrawn are 155 acres of BLM-administered surface/federal mineral lands in north central Sheridan County.
- Ed O. Taylor Big Game Winter Range – Also called the Ed O. Taylor WHMA, this area was originally named the Middle Fork Powder River Area. Withdrawn are 10,955 total acres of BLM-administered surface/federal mineral lands; approximately 10,695 acres in southwestern Johnson County in the Buffalo planning area, and approximately 260 acres in southeastern Washakie County in the adjacent Big Horn planning area).

There are three areas in the planning area that remain open to mineral entry (location of mining claims, and locatable mineral exploration and development) while they are under review by Congress for formal designation as Wilderness Study Areas (WSAs). However, such activities must be conducted under the purview of 43 CFR 3802, which incudes stringent requirements for maintaining non-impairment of the suitability of these lands for inclusion in the wilderness system. There are no 43 CFR 3802 locatable minerals operations occurring or planned in the three WSAs, likely due to the low potential for commercial amounts of locatable minerals in these areas. These areas are also currently restricted from leasable and salable minerals exploration and development, unless such activities would also not impair these areas' suitability conditions. If Congress acts to have any of these areas formally designated as WSAs, then withdrawal from mineral entry (closure to mineral location, and locatable minerals exploration and development) will be pursued for that area. If Congress denies formal designation for any of these areas, then that area will still remain open to mineral entry, although management of the area would likely include requirements to maintain much of the areas' unique features. The BLM's recommendation for all three areas is to not become wilderness. See *Special Designations – WSAs* for more information. These three areas are (see Map 63):

- Fortification Creek WSA – This area consists of 12,419 acres of BLM-administered surface/federal mineral lands in northeastern Johnson and northwestern Campbell counties. No locatable minerals are known to occur in this area in currently commercially viable quantities.
- Gardner Mountain WSA – This area consists of 6,423 acres of BLM-adminstered surface/federal mineral lands in southwestern Johnson County. No locatable minerals are known to occur in this area in currently commercially viable quantities.
- North Fork WSA – This area consists of 10,089 acres of BLM-administered surface/federal mineral lands in southwestern Johnson County. No locatable minerals are known to occur in this area in currently commercially viable quantities.

Sodium bentonite, gypsum, and uranium are the only locatable minerals for which the Buffalo Field Office has received Notices or POOs since the Buffalo RMP ROD was signed in 1985. These minerals are known to occur in the planning area in commercial quantities; however, only bentonite and uranium have been or are currently economic to produce. There are four authorized POOs in the planning area: two for developing sodium bentonite, and two for developing uranium; there are also two pending POOs: one each for developing sodium bentonite and uranium (see Table 3.13, “Current Authorized and Pending Bentonite Plans of Operation in the Buffalo Planning Area” (p. 252) and Table 3.14, “Current Authorized and Pending Uranium Plans of Operation (all ISR operations) in the Buffalo Planning Area” (p. 255)). See Table 3.11, “Active Mining Claims in the Buffalo Planning Area” (p. 248) for a listing by mineral of active mining claims located on federal lands (both federal surface/federal minerals and split estate) in the planning area.

Table 3.11. Active Mining Claims in the Buffalo Planning Area

Mineral	Number of Claims
Bentonite	47
Gold	3
Gypsum	1
Uranium	3,604
Two or more minerals (minerals not identified in the Notice)[1]	4,793
Total Active Mining Claims	**8,448**
Source: BLM 2008f [1]Based on known exploration interest and production, it is assumed that most of these claims were located for bentonite and uranium.	

Most bentonite mining in the planning area is concentrated west to southwest of Kaycee; gypsum also occurs in this area. Uranium mining is currently occurring in the Pumpkin Buttes Uranium District between Kaycee and Wright. This district surrounds the Pumpkin Buttes, in southeastern Johnson and southwestern Campbell counties. Some historic mining of uranium occurred in the Kaycee Uranium District, just east of Kaycee; no uranium mining occurs there currently. More information is provided in the following subsections by mineral. As mentioned earlier, other locatable minerals exist in the planning area, such as base and precious lode metals (such as gold, silver, platinum, and copper), and metallurgical-grade limestone, gemstones, and REEs. However, as these minerals are not known to occur in commercial quantities in the planning area, they are not discussed further or analyzed in Chapter 4. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information.

As with all mineral resources, the actual or potential occurrence of a locatable mineral in a given area does not mean that a deposit of that mineral exists there. Nor does it mean that any existing mineral deposit might be economically viable to produce, either now or in the future. Actual occurrence of a mineral means that the mineral is known to occur in that area; potential occurrence of a mineral indicates an increased probability of finding the mineral in that area (such as the occurrence of a rock type or geological structure that is likely to contain that mineral). The number of mining claims located, accepted Notices, and pending and approved POOs in the planning area may lead one to presume that the minerals indicated (such as sodium bentonite, gold, gypsum, uranium, etc.) are profitable to mine here. However, the numbers of these claims may be more suggestive overall of the public's interest in these minerals and demand for them than their profitability or probability to be mined here. Due to the greater financial investment needed to conduct operations described in a Notice or POO, the numbers of each of these types of projects are greater indicators of likely probability and profitability in developing those minerals in the planning area.

3.2.1.4. Trends

Bentonite is used in hundreds of products, ranging from household and beauty products, food products, in ore processing, and in the oil and gas and construction industries. According to the Wyoming Mining Association (WMA), bentonite deposits appear to be abundant in Wyoming, comprising approximately 70% of the world's known supply (Wyoming Mining Association 2002). Worldwide demand for bentonite (including the high-swelling sodium-containing “Wyoming-type” bentonite) has been rising nationwide, and worldwide production has been rising to meet the rising demand (USGS 2005; USGS 2009). The current economic downturn (beginning in late 2008) could see worldwide demand for all bentonite decrease over the long term, although production of Wyoming-type bentonite might not keep pace with demand (Global Information, Inc. 2009). Nationwide bentonite production increased 30% between 2000 and 2008 (USGS 2005; USGS 2009), while planning area bentonite production increased 62% over a slightly longer period, 2000 to 2010 (Wyoming Office of the State Inspector of Mines 2000 - 2010). Wyoming-type bentonite will likely continue to be in demand, due to its unique high-swelling property, which few other materials can match (Global Information, Inc. 2009). Table 3.12, "Annual Production of Bentonite and Uranium in the Buffalo Planning Area" (p. 249) lists amounts of bentonite produced in recent years from all mines in the planning area.

Table 3.12. Annual Production of Bentonite and Uranium in the Buffalo Planning Area

Year	Bentonite (tons)	Uranium (pounds)
2000	312,482	63,381
2001	400,309	37,990
2002	338,507	33,284
2003	431,718	23,693
2004	458,770	8,174
2005	492,368	3,104
2006	491,188	0
2007	548,066	0
2008	600,000	0
2009	497,796	0
2010	506,034	0
Source: Wyoming Office of the State Inspector of Mines 2000 - 2010.		

Gypsum is used in numerous products, including construction materials, fertilizer, as a water softener and clay binder, and for some medicinal purposes. There is no history of commercial gypsum mining in the planning area. Although gypsum occurs in the planning area near sodium bentonite, the development potential for gypsum is considered low. Despite fairly easy access to the deposits along the same roads used for bentonite mines, gypsum's low price, the relatively long distance from outcrops to the nearest processing facility in Casper, and the plentiful availability of gypsum elsewhere, has made development of gypsum in the planning area not cost-effective to date. This combination of factors is likely to continue well into the future, at least through the duration of the planning period.

The amount of uranium resources occurring in Wyoming, including the planning area, is not well known. Deposits can be identified and defined through exploration; interpretation of certain well logs from oil and gas wells can also provide information. Various uranium resources (as measured in pounds of triuranium octoxide [U_3O_8]) are anticipated to supply the forecasted rising demand until 2040; these include identified (and speculated) deposits, and uranium obtained from secondary sources (World Information Service on Energy 2007). Uranium production has varied greatly over the last 25 years, but has steadily risen worldwide. Since 1993, all uranium production in Wyoming has been from mines using in situ recovery (ISR) methods (Wyoming State Geological Survey 2009); however, one conventional mine (not in the planning area) has been recently proposed in Wyoming. Over the past several years (until the recent economic downturn beginning in late 2008), the price of U_3O_8 increased dramatically, leading to increased interest in uranium development and increased staking of mining claims (including in the planning area). However, statewide production has experienced an overall decline between 1980 and 2010 (Wyoming Office of the State Inspector of Mines 1980; Wyoming Office of the State Inspector of Mines 2010; Wyoming State Geological Survey 2009). Several ISR uranium operations in the planning area began groundwater restoration and mine reclamation in 2000; since late 2008 several have reverted to standby status or begun restart procedures, awaiting an increase in price; only one of the two authorized POOs in the planning areas is currently producing uranium. Amounts of uranium produced in recent years from all mines in the planning area are given in Table 3.12, “Annual Production of Bentonite and Uranium in the Buffalo Planning Area” (p. 249).

3.2.1.5. Key Features

Three locatable minerals occur in the planning area in quantities sufficient for commercial production: bentonite, gypsum, and uranium. However, only bentonite and uranium are currently mined; there is no history of gypsum production from the planning area, and it is not likely that gypsum will be mined during the planning period. Bentonite is volcanic ash-based clay, and is widely used as an absorbent and/or thickener in many products. The type of bentonite occurring in the planning area is a unique high-swelling sodium-containing type (also called Wyoming-type) that can absorb up to 10 times its own weight in water, and swell up to 16 times its original size. Gypsum is a water-soluble mineral used primarily in the construction industry. Both bentonite and gypsum occur in the planning area along the western Powder River Basin margin, and near the base of the Big Horn Mountains in southwestern Johnson County. The bentonite layers being mined occur in Cretaceous sedimentary rocks west to southwest of Kaycee, where the bentonite is relatively close to the surface. Gypsum occurs in Jurassic sedimentary rocks just west of the bentonite-containing strata. Uranium is a radioactive metallic element used primarily as a fuel for nuclear power generation, in various military applications, and in medicine and biology. Uranium deposits are found in scattered “roll-front” deposits in relatively shallow Eocene and Paleocene sedimentary rocks in southeastern Johnson and southwestern Campbell counties. See the subsections below by individual mineral for more information.

3.2.1.6. Locatable Minerals – Bentonite

3.2.1.6.1. Regional Context

Refer to *Regional Context* under the *Locatable Minerals* section above.

3.2.1.6.2. Indicators

Indicators that could be used to describe resource condition and assess the status of the bentonite resources in the planning area include the currently known quantities (actual and estimated quantities), historic and forecasted demand, and historic and forecasted production. As indicated earlier, these indicators, and the trends they reveal, are discussed here in relatively general terms.

3.2.1.6.3. Current Condition

Bentonite is a type of light-colored clay that is soft and plastic, and formed through chemical alteration of volcanic ash that was deposited millions of years ago. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more detailed information on bentonite formation. Three prominent bentonite beds are exposed in the planning area. The lowermost is the Clay Spur bed in the upper part of the Lower Cretaceous-age Mowry Shale, and ranges from 3 to 5 feet thick. Two other bentonite beds, averaging 2 feet each in thickness, are exposed in the Upper Cretaceous-age Frontier Formation above the Clay Spur bed. These three beds exhibit the very distinctive characteristics of bentonite deposits: they lack vegetation, the dry, weathered surfaces appear popcorn-like, and the fresh, unweathered surfaces appear waxy. Hard bentonite (chip material) occurs in scattered areas of both formations. These three beds are exposed near the western edges of the Powder River Basin, along the eastern flank of the Big Horn Mountains (Map 9).

Bentonite's property of absorption is largely due to its ion-exchange characteristics. Wyoming-type bentonite is a unique high-swelling sodium-containing type, which can absorb up to 10 times its own weight in water and swell up to 16 times its original size (Wyoming Mining Association 2002). Because sodium is a readily exchangeable ion, the sodium in many Wyoming bentonite deposits allows it to swell by absorbing water. This absorptive capacity is desirable for many uses, and few other materials can mimic this property. Bentonite is used in hundreds of products. Uses include absorbents, animal feed, drilling fluids, foundry, iron-ore pelletizing, sealants, and cat litter. It is used in drilling mud to lubricate oil-field drilling equipment, to hold back formation pressure, and to help prevent caving of the drill hole. It is used in the foundry industry for binding iron pellets which are later processed into a variety of metal alloys. Bentonite also provides the water-tight seal engineered into the layers placed under reservoirs and landfills. Other uses include crayons, medicine, cosmetics, and as both a food and non-food thickener.

All active bentonite production in the planning area is occurring in southwestern Johnson County, west to southwest of Kaycee (Map 9). Bentonite production varies with market demand and available stockpiles. Table 3.12, “Annual Production of Bentonite and Uranium in the Buffalo Planning Area” (p. 249) provides annual bentonite production from the planning area for recent years (2000 through 2010). Currently, there are 2 authorized active open-pit bentonite mines (Table 3.13, “Current Authorized and Pending Bentonite Plans of Operation in the Buffalo Planning Area” (p. 252)), 1 mine pending authorization, and 47 active bentonite mining claims (see Table 3.11, “Active Mining Claims in the Buffalo Planning Area” (p. 248)) on federal lands in the planning area (both federal surface/federal minerals and split estate).

Table 3.13. Current Authorized and Pending Bentonite Plans of Operation in the Buffalo Planning Area

Operator	Legal Description
Authorized:	
Black Hills Bentonite (Mayoworth Area Mine)	T. 44 N., R. 83 W., Sections 1, 2, 3, 10, 11, 12, 13, 14, &15 T. 45 N., R. 82 W., Sections 19, 30, & 31 T. 45 N., R. 83 W., Sections 22, 23, 24, 25, 26, 27, 34, 35, & 36*
Black Hills Bentonite (Petersen Draw/Willow Creek-Posey Creek/Tisdale-Wall Creek Areas Mine)	T. 41 N., R. 81 W., Sections 2, 3, 4, & 14* T. 42 N., R. 81 W., Sections 26, 27, 28, 33, 34, & 35* T. 41 N., R. 82 W., Sections 18, 19, 30, & 31* T. 41 N., R. 83 W., Sections 13, 24, 25, & 36 T. 42 N., R. 83 W., Sections 2, 3, 10, 11, 12, 13, 14, 15, 22, 23, & 24* T. 43 N., R. 82 W., Sections 6, 8, 18, 23, 28, & 31*
Pending:	
Black Hills Bentonite (North Fork Area)	T. 43 N., R. 83 W., Sections 15, 22, 23, 24, 26*
Source: BLM 2012f __* Contains BLM surface. N North R Range T Township W West	

3.2.1.6.4. Trends

Wyoming bentonite deposits (known and estimated) appear to be abundant, comprising approximately 70% of the world's known supply, and Wyoming is the primary producer of high-swelling sodium-type bentonite in the world (Wyoming Mining Association 2002).

Demand for bentonite (including Wyoming-type) has been somewhat steady nationwide between 2000 and 2010 (USGS 2005; Virta 2011). However, the current economic downturn beginning in late 2008 could see worldwide demand decrease over the long-term, as construction and oil and gas development continues to slow; alternative materials may also be discovered (Global Information, Inc. 2009). However, new uses for bentonite continue to be found, and worldwide dips in demand for some uses may be countered by increases for others. A modest worldwide increase in demand of 2.2% per year through 2012 is forecast (Global Information, Inc. 2009). Although worldwide demand for Wyoming sodium-type bentonite is expected to decrease, it is likely production may not keep pace, leading to tighter supplies in the short term (Global Information, Inc. 2009). It is likely that Wyoming–type sodium-containing bentonite will continue to be in demand, due to its unique high-swelling capability, which few other currently-known materials can match (Global Information, Inc. 2009).

The nationwide production of bentonite has been somewhat steady, with 4.5 billion tons produced in 2000 and 4.4 billion tons in 2010 (USGS 2005; Virta 2011). During the same period, Wyoming bentonite production remained somewhat steady, from 4.18 million tons to 4.04 million tons (Wyoming Office of the State Inspector of Mines 2000 - 2010). Production of bentonite in the planning area has risen 62% during that period, from 312,482 tons to 506,034 tons (Wyoming Office of the State Inspector of Mines 2000 - 2010). Wyoming bentonite production has steadily risen over the years, from 1,141 tons in 1927 to 4.04 million tons in 2010 (Wyoming Office of the State Inspector of Mines 2000 - 2010). During the economic downturn that began in late 2008, Wyoming production is anticipated to slow (Global Information, Inc. 2009). Production in the planning area is currently only occurring west to southwest of Kaycee; this is likely to remain the main producing area, with one new POO received for this area. Table 3.12, “Annual Production of Bentonite and Uranium in the Buffalo Planning Area” (p. 249) lists production amounts for bentonite mines in the planning area between 2000 and 2010.

3.2.1.6.5. Key Features

Bentonite beds are exposed along the western edge of the Powder River Basin near the eastern flank of the Big Horn Mountains (Map 9). There are three prominent bentonite beds in the planning area: lowermost is the 3- to 5-foot thick Clay Spur bed in the upper part of the Lower Cretaceous age Mowry Shale; the other 2 beds average 2 feet thick each and each occur in the Upper Cretaceous age Frontier Formation, above the Clay Spur bed. Although it is likely that some amount of bentonite can be found in these two formations all along the western edge of the Powder River Basin, the quantity and quality in a given area might not be sufficient to make it economically viable.

3.2.1.7. Locatable Minerals – Gypsum

3.2.1.7.1. Regional Context

Refer to *Regional Context* under the *Locatable Minerals* section above.

3.2.1.7.2. Indicators

There is no history of gypsum mining in the planning area. The long distance from outcrops to the nearest processing facility, gypsum's relatively low price, and plentiful availability elsewhere has made development of gypsum in the planning area not cost-effective. This combination of factors is likely to continue well into the future (including the duration of the planning period).

3.2.1.7.3. Current Condition

Gypsum is a water-soluble mineral used in numerous products, including drywall (also known as wallboard or sheetrock), plaster, cement, and fertilizer, and as a water softener and clay binder, and for some medicinal purposes. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information on the formation of gypsum. There is no history of gypsum mining in the planning area. The development potential for gypsum in the planning area is considered low. Despite fairly easy access to these deposits along the same roads used for bentonite mines, the low price of gypsum, the long transport distance to the nearest processing plant (in Casper, approximately 150 miles), and abundant occurrences of gypsum elsewhere, combine to make gypsum not cost-effective to develop in the planning area. This set of circumstances is not likely to change during the planning period. There is only one active mining claim for gypsum in the planning area (see Table 3.11, “Active Mining Claims in the Buffalo Planning Area” (p. 248)).

3.2.1.7.4. Trends

As noted above, the development potential for gypsum in the planning area is considered low. This is due to the low price of gypsum, the long distance to the nearest processing facility, and abundant occurrence elsewhere. This situation is not likely to change well into the future.

3.2.1.7.5. Key Features

Gypsum occurs in the same areas in the planning area as bentonite – all along the western edge of the Powder River Basin near the eastern flank of the Big Horn Mountains (Map 9). Most gypsum in the planning area occurs within three formations: the redbeds of the Goose Egg and Chugwater Formations, and in the Gypsum Springs Formation. These gypsum beds vary in thickness, quality, and areal extent throughout these formations, making it difficult to estimate the amount of this resource.

3.2.1.8. Locatable Minerals – Uranium

3.2.1.8.1. Regional Context

Refer to *Regional Context* under the *Locatable Minerals* section above.

3.2.1.8.2. Indicators

Indicators that could be used to describe resource condition and assess the status of the uranium resource in the planning area include currently known quantities (known and estimated quantities), historic and forecasted demand, and historic and forecasted production. As indicated earlier, these indicators, and the trends they reveal, are discussed here in relatively general terms.

3.2.1.8.3. Current Condition

Uranium is a radioactive metallic element used primarily as a fuel for nuclear power generation, in various capacities in military arms and armor production, and in certain fields of medicine and biology. In the planning area, uranium is known to occur in economically viable quantities in two formations: the Paleocene age Fort Union Formation, and the Eocene age Wasatch Formation. Uranium is also known to occur in a number of other formations in the Powder River Basin, but the quantity and/or quality is generally very low and these will not be discussed further. There are two uranium districts in the planning area: the Pumpkin Buttes Uranium District in southeastern Johnson and southwestern Campbell counties between Kaycee and Wright, and the Kaycee Uranium District in south-central Johnson County (Map 9). Most uranium in the planning area has been produced from the larger Pumpkin Buttes District; all current mining is occurring in this district. These two areas contain “roll-front” type uranium deposits in the sandstones of the Fort Union and Wasatch formations. These deposits form when water carrying dissolved and oxidized uranium (picked up while passing through uranium-containing rocks and sediments) encounters a chemically reducing environment (created by the presence of sulfides such as pyrite or hydrogen sulfide) and/or organic matter (such as coal, crude oil, or natural gas) in the sandstone and the uranium precipitates out of solution. These deposits accumulate over millions of years, as very large amounts of groundwater containing small amounts of uranium pass through the sandstones. Typical ore bodies in the planning area contain only 1 to 2% uranium. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more detailed information on the formation of this deposit type.

Uranium is mined using surface mining, underground mining, or ISR techniques. Since 1993, all uranium production in Wyoming has been from mines using ISR methods (Wyoming State Geological Survey 2009), although one recently proposed mine in Wyoming (not in the planning area) will be surface mined. In the ISR method, the uranium is dissolved back into the groundwater of the sandstone aquifer using an oxidizing chemical, such as sodium bicarbonate, gaseous CO_2, or sulfuric acid; this is a reversal of how the uranium was deposited in the aquifer: by reduction as it encounters organic material. The groundwater containing the dissolved uranium is pumped to the processing facility on the surface. Using ion exchange columns containing tiny beads of polymer resin, the uranium is "stripped" out of the groundwater solution by converting it to a solid once again. The solid uranium is flushed from the ion exchange column with water into large collection vessels. The uranium is now much more concentrated than it was in the aquifer. The water gained during the flushing from the column is removed by dewatering, and the solid uranium can be dried and packaged for shipment. The resulting uranium ore (called yellowcake) is shipped to an enrichment facility to concentrate the fissionable uranium to a level useful for the desired application. The quantity of uranium resources in Wyoming, including the planning area, is not well known. However, deposits can be further defined through exploration and from information interpreted from certain well logs from oil and gas wells.

The price of U_3O_8 increased dramatically over the past several years (until the recent economic downturn beginning in late 2008), resulting in increased staking of mining claims, including in the planning area's Pumpkin Buttes District.Table 3.12, "Annual Production of Bentonite and Uranium in the Buffalo Planning Area" (p. 249) provides production amounts from uranium mines in the planning area for recent years (2000 through 2010). In the planning area, there are two authorized uranium ISR POOs and one pending authorization. One authorized POO (Willow Creek) is currently producing uranium (see Table 3.12, "Annual Production of Bentonite and Uranium in the Buffalo Planning Area" (p. 249)); this is their first production after nearly 9 years on standby status. The second authorized POO (Ruth) remains inactive after many years; it is uncertain when this mine will restart operations. The POO pending authorization (Nichols Ranch/Hank Unit) obtained an NRC Source Material License and a WDEQ LQD Mine Permit; construction of facilities has begun on the non-BLM portion of the POO (Nichols Ranch). See Table 3.14, "Current Authorized and Pending Uranium Plans of Operation (all ISR operations) in the Buffalo Planning Area" (p. 255) for the list of uranium POOs in the planning area.

Table 3.14. Current Authorized and Pending Uranium Plans of Operation (all ISR operations) in the Buffalo Planning Area

Operator	Legal Description
Authorized:	
Uranium One Americas (Willow Creek Mine; formerly Christensen Ranch/Irigaray Mine)	T. 44 N., R. 76 W., Sections 3, 4, 5, 6, 7, 8, 9, 10, 16, 17, 18, 19, 20, 21, 28, 29, & 30 T. 44 N., R. 77 W., Sections 1, 2, 3, 10, 11, & 12* T. 45 N., R. 76 W., Sections 19, 30, 31, 32, & 33 T. 45 N., R. 77 W., Sections 5, 8, 9, 16, 24, 25, 34, & 35*
Cameco, also called Power Resources (Ruth Mine)	T. 42 N., R. 77 W., Sections 13, 14, 23, 24, 25, & 26*

Operator	Legal Description
Pending:	
Uranerz Energy Corporation (Nichols Ranch/Hank Unit Mine)	T. 43 N., R. 75 W., Sections 5, 6, 7, & 8* T. 43 N., R. 76 W., Sections 7, 8, 17, 18, & 20 T. 44 N., R. 75 W., Sections 30, & 31*
Source: BLM 2008d __* Contains BLM surface. N North R Range T Township W West	

3.2.1.8.4. Trends

The amount of uranium resources in Wyoming, including the planning area, is not well known. However, individual deposits can be further delineated through exploration drilling and interpretation of certain well logs from oil and gas wells. Identified and speculated worldwide uranium resources (as measured in pounds of U_3O_8) are estimated to range from 6.6 billion pounds to 20 billion pounds (World Information Service on Energy 2007). See Table 3.14, “Current Authorized and Pending Uranium Plans of Operation (all ISR operations) in the Buffalo Planning Area” (p. 255) for the current number of active uranium claims in the planning area. Known and speculated (estimated) worldwide resources (as measured in pounds of triuranium octoxide [U_3O_8]) are estimated to range from 6.6 billion pounds to 20 billion pounds (World Information Service on Energy 2007).

Worldwide demand for uranium has steadily risen, and is anticipated to continue rising. Demand in 2005 was 133.7 million pounds of U_3O_8, demand in 2020 is estimated to be 166 million pounds of U_3O_8 (1.25 times current demand), and demand in 2050 is estimated to range from 350 to 530 million pounds of U_3O_8 (2.5 to 4 times current demand), depending on how much electrical generation capacity is transferred from conventional fuels (such as coal) to nuclear power plants (World Information Service on Energy 2007). There are reportedly 443 operating commercial nuclear reactors in the world (Energy Information Administration 2009); 104 of these in the United States (Nuclear Regulatory Commission 2009). There is currently a gap between worldwide production and demand, and this gap is anticipated to increase with passing time. In 2005, worldwide production met only 62% of worldwide demand, requiring the remaining 58% be obtained from secondary sources. These sources included reprocessing and re-enrichment of partially spent fuel rods and other products from military programs; processing and enrichment of lower quality ores and mine tailings; and from inventories held by utilities, other fuel cycle companies, and governments (World Information Service on Energy 2007). The gap between production and demand is estimated to increase up to 98% by 2050 (World Information Service on Energy 2007). Known and speculated worldwide resources, along with secondary sources, could supply the forecasted demand as far into the future as year 2040 (World Information Service on Energy 2007).

Uranium production has experienced many ups and downs nationwide and statewide since the existing RMP was implemented in 1985. Production worldwide has steadily risen, and the domestic uranium market faces strong competition from foreign sources (World Information Service on Energy 2007). Total nationwide uranium mine production in 2007 was 4.54 million pounds (Energy Information Administration 2008). Statewide production has steadily dropped from 2.5 million pounds in 2000, to 1.2 million pounds in 2008, and to 0 pounds in 2010 (Wyoming State Geological Survey 2009; Wyoming Office of the State Inspector of Mines 1980; Wyoming Office of the State Inspector of Mines 2010; Cameco 2011). Several ISR uranium operations in the planning area began groundwater restoration and mine reclamation in 2000; since late 2008, several have reverted to standby status or begun restart processes, awaiting an increase in price; one has started producing again. Table 3.12, “Annual Production of Bentonite and Uranium in the Buffalo Planning Area” (p. 249) lists production amounts for uranium mines in the planning area for recent years (2000 through 2010).

3.2.1.8.5. Key Features

In the planning area, commercial amounts of uranium are known to be found in the sandstones in the Fort Union and Wasatch formations. There are two uranium districts in the planning area: the Pumpkin Buttes Uranium District in southwestern Campbell and southeastern Johnson counties between Kaycee and Wright, and the Kaycee Uranium District in south-central Johnson County (Map 9). Most historic, and all current, production in the planning area has been from the larger Pumpkin Buttes District. Since 1993, all uranium production in Wyoming has been from mines using ISR methods (Wyoming State Geological Survey 2009), although one recently proposed mine plans to produce using conventional methods. These two areas contain “roll-front” type deposits of uranium in sandstones. Ore-grade mineralization generally averages a few tenths of one percent uranium, up to two percent uranium near the center of the ore body. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information regarding the formation of these types of deposits.

3.2.2. Leasable Minerals – Coal

3.2.2.1. Regional Context

The Powder River Basin in Wyoming and Montana contains some of the largest accumulations of low-sulfur sub-bituminous coal in the world. Being aware of the value of these coal deposits, as the lands were settled in the early 1900s, the federal government retained the mineral rights to the coal. As part of the Federal Coal Management Program, the Powder River Basin of Wyoming and Montana was designated a federal coal production region in the 1970s.

Thick coal deposits occur at or near the surface along the eastern boundary of the planning area, along a north-south trend situated east of both Gillette and Wright, and in the northwestern portion of the planning area. Coal occurs at depth, below the surface, throughout most of the remainder of the planning area. Coal from the Powder River Basin in Wyoming is valued for its clean-burning properties. The majority of the coal activity within the WY Powder River Basin lies within the Buffalo Field Office administrative boundary.

The Powder River Basin is the Nation’s largest coal-producing region, and coal from the region is shipped nationwide. Most Powder River Basin coal production comes from the Buffalo planning area. In 2008, the 451.6 million tons of coal produced from the planning area represented 38.6% of U.S. domestic coal production. While both Powder River Basin and U.S. production decreased in 2009 in response to a national recession, Buffalo planning area production, at 419.6 million tons, represented 39.1% of domestic production.

The Powder River Basin also has been the nation's fastest growing coal producing region. U.S. coal production increased 4.2% from 1,029 million tons in 1990 to 1,072 million tons in 2009. Powder River Basin coal production increased from 184.0 million tons in 1990 to 419.6 million tons in 2009, an increase of 228%.

Coal Resource Description

Glass (1997) describes important coal seams of the Powder River Coal Field in Wyoming. The following paragraphs summarize these descriptions. Important coal seams in the Wasatch Formation, from oldest to youngest, include the School, Badger, Felix, and Lake DeSmet coals. Important coal seams in the Fort Union Formation, from oldest to youngest, include the Canyon, Anderson, Wyodak, and Big George coals. Thousands of coalbed natural gas holes drilled during the past decade have given us a much more comprehensive idea of where the coalbeds are. More current assessments of coal stratigraphy are now available. According to Flores et al. (2010), for example, the Anderson and Canyon, as well as the Badger and School coalbeds, are splits of the Wyodak coal zone and the Big George is also associated with the Wyodak. Luppens et al.(2008) consider the Big George to equate with the Smith coal deposit above the Wyodak. Coalbeds split and merge in a more complex fashion than previously recognized, and even may "corkscrew" above themselves on a regional basis according to Goolsby and Finley (2000). Individual coal layers are the most continuous rock units in the Fort Union and Wasatch Formations and may extend for tens of miles, splitting and merging with other coal layers, before pinching out, or burning to form clinker or eroded away where exposed along an outcrop. The Wyodak coal deposit consists of both the Anderson and Canyon, and is not a separate deposit of coal. Tongue River Member coals in the Fort Union that are mined include from youngest to oldest are – Roland; Wyodak Rider-Smith (also known as Big George); Upper Wyodak – Anderson; Lower Wyodak – Canyon.

The Wyodak coal zone has the largest strippable reserve base of any coal in Wyoming. It lies near the top of the Fort Union Formation, and formed from decay of plants that lived and died in swamps about sixty million years ago. The coal mines east of Gillette and Wright produce from the Wyodak, near its outcrop where the overburden thickness is lowest, and therefore most profitable to mine. As-received quality of this coal generally ranges from 8,200 to 8,800 British thermal units (BTU) per pound (higher towards the south). Sulfur content averages 0.2 to 0.4%, and ash content averages 5 to 7%; the low sulfur content makes it attractive to supply power plants nationwide. In the Gillette coal field, the main Wyodak beds (Anderson, Rider, Anderson, Dietz, and Canyon beds) contain a total of 125 billion tons of in-place resources, of which 6 billion have been mined as of 2008 (Luppens et al. 2008). The overlying Smith and Roland beds contain an additional 38 billion tons. Where the beds have merged in the areas of Gillette and Wright, the Wyodak (Anderson) is as much as 202 feet thick, but generally averages 45 feet thick (Luppens et al. 2008). The merged Wyodak coal splits to the north, west and south into several beds, including the Anderson and Canyon, and is eroded or burned to the east (Flores et al. 2010). There are extensive clinker (scoria) deposits east of the coal mines, which resulted from the natural burning of the Wyodak coal near its outcrop in prehistoric to recent times.

The School and Badger coals were developed in the Dave Johnston deposit in the southern part of the Powder River Basin. Mining in this area is no longer active. The Felix coal is a persistent coal deposit in the northern and central portions of the planning area, and varies from 5 to 20 feet thick, but is up to 50 feet thick in the central and southern portions of Campbell County. Felix coal exposures east of the Powder River in southern Campbell County have been burned have burned to form reddish clinker-capped hills in the vicinity of Gillette and Wright (Coates and Heffern 1999). The Felix coal is not currently mined.

The Lake DeSmet coal is the thickest known coal deposit in the contiguous United States. Although limited in areal extent, in the northwestern portion of the planning area the Lake DeSmet coal is 250 feet thick. The Lake DeSmet coal is not currently mined, and the uppermost portions of this coal deposit are burned over much of its area of occurrence. Lake DeSmet itself occupies a basin formed by the natural burning of this thick coal.

The Big George coal is not exposed at the surface. It occurs in the subsurface of the west central portion of the Powder River Basin at depths between 1,000 and 2,000 feet and is not currently mined. The Big George is up to 216 feet thick and is correlative with the Smith coal, this coal is mined north of Gillette as part of the Wyodak Rider coal zone.

3.2.2.2. Indicators

Powder River Basin coal is a very important commodity and plays a large role in the economy of the State of Wyoming and the U.S., and an important role in determining electric power prices and availability nationwide. Demand for Powder River Basin coal relates directly to national electric power demand. Historically, Powder River Basin coal production has increased at a more rapid rate than national electric demand, because environmental and cost factors make Powder River Basin coal favored in the competitive coal market. Powder River Basin coal is sulfur compliant; therefore, it costs less to reduce SO_2 emissions, the coals are surface mined in high volume (efficient mines resulting in low production costs), and reclamation has been demonstrated effective and reliable. These advantages indicate the Powder River Basin coal will maintain or improve its presence in the domestic coal production mix.

The BLM role in Powder River Basin coal production is to lease coal reserves in an environmentally responsible manner at a rate that will maintain reserves under lease to reliably meet coal demand. The BLM also must conduct its coal leasing program to ensure that the public receives fair and full value for the coal resources and that leasing for speculation does not occur.

3.2.2.3. Current Condition

Development Activity

There has been small scale coal mining throughout the Buffalo planning area since the early 1900s, primarily in Sheridan and Campbell counties. There was substantial coal leasing activity between 1955 and 1970; however, much of the leasing was speculative because actual coal production decreased during this period. In the early 1970s, there was an extensive period of major mining starts and production growth. Almost all of this development was in Campbell County where 16 major coal mining operations opened. The 1980s were a time when these operations matured into major national coal producers. During the 1990s, one additional mining operation opened and three were consolidated with existing mines. After 2000, there were three more consolidations.

There are currently 12 (13 counting the Jacobs Ranch mine which was recently consolidated with the Black Thunder mine) operating mines in the planning area. All are in Campbell County (part of the Antelope Mine is in Converse County). There are presently two mining operations proposed to be opened on existing federal coal leases or on privately owned coal. One of these proposed mining operations is located in Sheridan County. All of the existing or proposed mining operations would be surface coal mines, using truck/shovel or dragline mining methods. Table 3.15, “Status and Ownership of Wyoming Powder River Basin Coal Mines ” (p. 260) lists the names of these mining operations and the 2009 coal production from each.

Table 3.15. Status and Ownership of Wyoming Powder River Basin Coal Mines

Mine	1994 Mine Owner	2009 Mine Owner	2009 Coal Production (million metric tons)[1]	Permitted Production Level (million metric tons)[2]	Status and Additional Comments
Buckskin	SMC (Zeigler)	Buckskin Mining Properties	25.4	42	Active
Dry Fork	Phillips/WFA & Fort Union Ltd	Western Fuels - Wyoming	5.2	15	Active (includes former Fort Union Mine)
Eagle Butte	Cyprus-Amax	Alpha Coal West	21.5	35	Active
Rawhide	Carter (Exxon)	Caballo Coal LLC	15.8	24	Active
Wyodak	Wyodak Resources	Wyodak Resources	6.0	12	Active (includes former Clovis Point Mine)
Belle Ayr	Cyprus-Amax	Alpha Coal West	28.7	45	Active
Caballo	Carter (Exxon) & Western Energy	Powder River Coal Co.	23.3	50	Active (includes Rocky Butte and West Rocky Butte leases)
Cordero Rojo	Kennecott & Drummond	Cloud Peak Energy LLC	39.4	65	Active (consolidation of former Cordero and Caballo Rojo Mines)
Coal Creek	ARCO	Arch Coal Inc.	9.8	50	Active
Antelope	Kennecott	Cloud Peak Energy LLC	34.0	42	Active
Black Thunder	ARCO	Arch Coal Inc.	81.1	100	Active
Jacobs Ranch	Kerr-McGee	Arch Coal Inc.	29.3	50	Active (purchased in 2009 by Arch – being consolidated with Black Thunder)
N. Antelope/ Rochelle	Peabody	Powder River Coal Co.	98.3	140	Active (consolidation of former North Antelope and Rochelle Mines)
School Creek		West Roundup Resources	0		Inactive, new mine, permitted by Wyoming DEQ
N. Rochelle	SMC (Zeigler)	Arch Coal Inc.	0	35	Inactive since 2005, leases split between Black Thunder and North Antelope Rochelle Mines

Mine	1994 Mine Owner	2009 Mine Owner	2009 Coal Production (million metric tons)[1]	Permitted Production Level (million metric tons)[2]	Status and Additional Comments
Youngs Creek		Consol and P&M Coal	0		Proposed mine in Sheridan county, permit application pending at Wyoming DEQ
Total			**417.8**	**705**	

Source: Wyoming Office of the State Inspector of Mines 2009

[1]Wyoming State Inspector of Mines (2009)
[2]Wyoming DEQ air quality permit levels

DEQ Department of Environmental Quality

Coal Management

Congress enacted the Mineral Leasing Act in 1920. As a result, coal was no longer subject to mineral location (mining claims). Coal became a leased commodity, with development by a federal coal lessee in compliance with the terms and conditions of the lease. The BLM is the DOI agency responsible for mineral leasing under the Mineral Leasing Act.

Under the Mineral Leasing Act, coal was leased both competitively and non-competitively. Competitive leasing occurred in areas identified as “known coal leasing areas” (KCLAs) based on the knowledge that minable coal was in these areas. Non-competitive leasing was allowed outside KCLAs, based on a party obtaining a prospecting permit, and through prospecting, establishing a preference right to a lease by proving that the lease area contained coal in commercial quantities.

The 1976 Federal Coal Leasing Amendment Act (FCLAA) amended the Mineral Leasing Act specific to coal. The FCLAA eliminated new non-competitive coal leasing. It required diligent development and continued operations on coal leases, required the public get fair market value for leases sold, and required that the BLM ensure maximum economic recovery. The FCLAA further required that lands available for federal coal leasing be identified as the result of a multiple-use, interdisciplinary land use planning process.

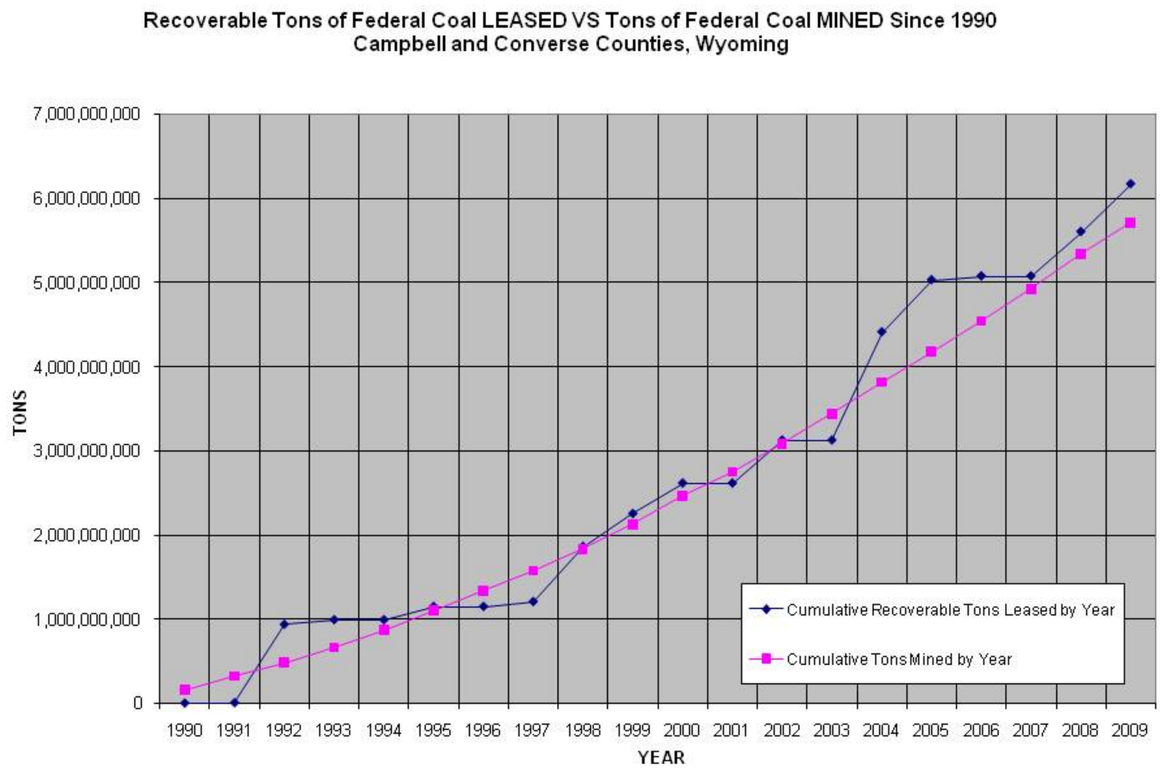
The Federal Coal Management Program was adopted in 1979 in line with the above legislation, and the contemporaneously enacted FLPMA and Surface Mining Control and Reclamation Act. The 43 CFR 3400 regulations guide the BLM coal program management, setting requirements for land use planning, leasing (whether by regional, lease-by-application, and lease modifications), and post lease maintenance.

Since 1985, federal coal resources in the Buffalo planning area have been managed under the guidelines of the existing Buffalo RMP, including a major update in April 2001. The RMP provides a framework for coal resource management, including exploration and leasing. The RMP includes specific land use planning and coal screening, and direction on competitive coal leasing. All pending preference right lease applications (PRLAs) have been processed under the RMP's direction, The BLM goal for coal resource management in the Buffalo planning area is to meet reserve needs to maintain currently operating mines, consistent with environmental protections, coal resource conservation, and fair market value return to the government and public.

On February 9, 1989, the DOI proposed to decertify all or a portion of the Powder River Basin Coal Production Region. This notice described the process the Regional Coal Team (RCT) would follow if total decertification was implemented (54 *Federal Register* [FR] 6339) and added "The RCT would recommend to the Secretary of the Interior to revise its charter to allow it to guide lease-by-application within the region." After the decision to decertify the Powder River Coal Production Region was published on January 9, 1990 (55 FR 784), the Secretary of the Interior signed the new Charter for the Powder River Regional Coal Team on June 6, 1990.

The Powder River Basin coal production region had reached production maturity by 1989. As noted earlier, new mining operations were not starting, and producing mines were well established, with some consolidation. Several existing mines had substantially depleted the reserves that the mine had opened on, and created a need for leasing so that existing mines could maintain production capability. Such production maintenance leasing could only work effectively in a decertified coal production region. In a coal production region where the regional lease sales mechanism was required, all tracts had to be offered in one large regional lease sale, with sales scheduled not in response to reserve depletion, but instead based on a single sale date. This works in an area where new mines will be developed, and for competition for new coal mining properties, but is unworkable where existing mines compete for sales in an open coal market, deplete their existing leases at market rates, and need to replace reserves throughout time. Regional leasing, if continued in the Powder River Basin, would have resulted in a reduced return to the public from coal sales (due to sale timing), a higher potential for bypass, and likely speculation in leases.

Aware that production maintenance leasing must be actively managed, the BLM has timed and sized the offering of leasing by application (LBA) tracts so that leasing new reserves parallels depletion of leased reserves. This is important to ensure that coal operators have adequate reserves to compete in the open coal market into which Powder River Basin coal is sold, while not offering coal resources in amounts that would encourage speculation. Figure 3.20, "Recoverable Tons of Federal Leased vs. Tons of Federal Coal Mined since 1990, Campbell and Converse Counties, Wyoming" (p. 262) shows the results of this management since 1990.



Source: BLM 2012k

Figure 3.20. Recoverable Tons of Federal Leased vs. Tons of Federal Coal Mined since 1990, Campbell and Converse Counties, Wyoming

Coal Planning

For federal coal resources, there are specific planning requirements beyond the BLM land use planning regulations. These coal planning regulations are found in 43 CFR 3420.1. Specifically, under 43 CFR 3420.1-4, federal coal lands must be: (1) screened for development potential; (2) reviewed against specific coal unsuitability criteria (see 43 CFR 3461); (3) screened for multiple use constraints; and (4) where the surface is privately owned (as in the Powder River Basin), surface owners must be consulted. This process results in a determination of areas acceptable for further consideration for coal leasing, under 43 CFR 3420.1-8. Leasing during the lifetime of the RMP is limited to those acceptable areas, unless the RMP is amended.

Coal planning was originally done in 1977 as part of a Management Framework Plan (a predecessor of RMPs), then done again for the 1985 RMP, and was done once again for the 2001 RMP update. In addition, as part of each coal leasing environmental assessment (EA) or environmental impact statement (EIS), coal planning is reviewed and updated using the most recent site-specific data for the application area.

In the 1985 RMP, the priority areas available for consideration of coal leasing covered approximately 484,000 acres. After the coal screening process, approximately 378,000 acres containing approximately 26 billion tons of coal remained. All areas available for coal leasing consideration was limited to the high-priority area. Coal lands available for leasing in the Thunder Basin National Grasslands is constrained by USFS land use plans.

As presented in the April 2001 update of the Buffalo RMP, the four coal planning screens were applied and coal decisions updated in coordination with the USFS and other cooperators. The area of coal development potential was revised, the application of the 20 unsuitability criteria was reviewed and revised based on current data and policy, multiple use decisions were carried forward, and surface owner consultation was conducted (BLM 2001a).

The 2001 coal planning update is the basis for current coal management in the planning area. In this update, BLM reviewed 567,200 acres in two areas of high coal development potential in the Buffalo Field Office (494,000 acres in Campbell County and 73,200 acres in Sheridan County). These areas contain an estimated 50.25 billion tons of coal. As a result of the update, 63,600 acres over 6.2 billion tons of coal were determined to be unsuitable for surface coal mining operations, while the remainder of the coal lands in these areas remained available for further consideration for coal leasing. Areas were found unsuitable for surface coal mine operations. The primary multiple use conflict was between oil and gas operations and coal mining, which is resolved by a special condition on leases. Surface owner consultation was completed and documented.

In 2002, there were three plan maintenance actions to clarify the 2001 updated description of existing management.

Preference Right Lease Applications

As explained in the 1985 Buffalo RMP, there were a number of pending PRLAs. The PRLAs covered more than 76,000 acres and about 5.7 billion tons of coal. The RMP directed that existing PRLAs be processed. All remaining PRLAs were processed (they were either rejected or withdrawn) and the cases closed.

Regional Sales

After the Powder River Basin federal coal production region was established in 1979, federal coal lands were available for leasing through the competitive process outlined in 43 CFR 3420. This method required leasing regional sales. A number of coal tracts are identified based on industry interest and the tracts addressed in a regional EIS. After the EIS process is completed, a number of sale tracts are chosen and all offered in one sale. The first regional sale was in 1982; six tracts were offered and sold. Most of the tracts sold during the sale had one bidder. One tract did not receive the minimum bid value and was later re-offered and sold. One tract had two bidders.

The second sale referred to in the 1985 RMP had been proposed in a 1984 Powder River Basin regional coal Draft EIS issued in 1984. Several tracts were identified in this round of leasing. The Round II (1984) sale was canceled. This was partly due to allegations of misconduct by government officials stemming from the 1982 lease sale, partly from concerns that regional sales were causing increased socioeconomic impacts, and partly due to a flattening coal market. The sale was suspended by a Federal Bureau of Investigation and other law enforcement investigation of some of the persons involved in the Round I (1982) sale for criminal wrongdoing. No individual was indicted or prosecuted because there was no evidence of criminal intent; however, the investigation and attention identified vulnerabilities in the regional sale process.

The investigation triggered the Linowes Commission, which studied the regional sale process and made several findings and recommendations for improvement that were integrated into the program by Secretarial decision.

Between 1985 and 1990, the coal lands outlined as priority for coal leasing in the existing plan were the only lands considered for competitive leasing. These lands were available for leasing through the regional sale process. There was no leasing between 1982 and 1989 because there was not enough industry interest or regional need for a second regional sale. However, existing operators were running short on reserves in many cases.

Leasing by Application

The Powder River Basin began operating in 1990 as a decertified coal production region, and continues to operate in that way. The RCT is still in place and meets periodically to review regional activity and make recommendations on coal leasing. Since decertification to present, 21 LBA tracts have been offered for competitive lease sale in the Powder River Basin and 20 leased. At present 12 LBA tracts are pending, all of which have been recommended for processing by the Powder River Basin RCT and are in various stages of processing. Table 3.16, " Successful Lease Sales" (p. 265) lists successful production maintenance sales since 1990. Table 3.17, " Lease by Application Pending, Powder River Basin, Wyoming" (p. 266) lists pending LBAs that have been reviewed by the RCT.

Table 3.16. Successful Lease Sales

Lease by Application Name	Lease Number	Effective Date	Acres	Tons	BID	Cost per Ton
Jacobs Ranch	WYW 117924	10/1/1992	1,708.62	161,216,000	$20,114,930.00	$0.125
West Black Thunder	WYW 118907	10/1/1992	3,492.495	429,048,216	$71,909,282.69	$0.168
North Antelope/ Rochelle	WYW 119554	10/1/1992	3,064.04	403,500,000	$86,987,765.00	$0.216
West Rocky Butte	WYW 122586	1/1/1993	463.205	55,000,000	$16,500,000.00	$0.300
Eagle Butte	WYW 124783	8/1/1995	1,059.175	166,400,000	$18,470,400.00	$0.111
Antelope	WYW 128322	2/1/1997	617.2	60,364,000	$9,054,600.00	$0.150
North Rochelle	WYW 127221	1/1/1998	1,481.93	157,610,000	$30,576,340.00	$0.194
Powder River	WYW 136142	9/1/1998	4,224.225	532,000,000	$109,596,500.00	$0.206
Thundercloud	WYW 136458	1/1/1999	3,545.503	412,000,000	$158,000,008.50	$0.383
Horse Creek	WYW 141435	12/1/2000	2,818.695	275,577,000	$91,220,120.70	$0.331
North Jacobs Ranch	WYW 146744	5/1/2002	4,982.24	537,542,000	$379,504,652.00	$0.706
Naro South	WYW 154001	9/1/2004	2,956.7	297,469,000	$274,117,684.00	$0.922
Little Thunder	WYW 150318	3/1/2005	5,083.5	718,719,000	$610,999,949.80	$0.850
West Hay Creek	WYW 151634	1/1/2005	921	142,698,000	$42,809,400.00	$0.300
West Antelope	WYW 151649	3/1/2005	2,809.13	194,961,000	$146,311,000.00	$0.750
Naro North	WYW 150210	3/1/2005	2,369.4	324,627,000	$299,143,785.00	$0.922
West Roundup	WYW 151134	5/1/2005	2,802.510	327,186,000	$317,697,610.00	$0.971
Eagle Butte West	WYW 155132	5/1/2008	1,427	255,000,000	$180,540,000.00	$0.708
Maysdorf South	WYW 174407	8/1/2008	2,900	288,081,000	$250,800,000.00	$0.871
Maysdorf North	WYW 154432	5/1/2009	445.89	54,657,000	$48,098,424.00	$0.880
Total			49,172.458	5,793,655,216	$3,162,452,451.69	
Source: BLM 2012k						

Table 3.17. Lease by Application Pending, Powder River Basin, Wyoming

LBA (Applicant Name)	Acres as Applied For	Estimated as Applied for Coal (million metric tons)
West Antelope II (Antelope)[1]	4,109	430
Belle Ayr North (Belle Ayr)	1,579	200
West Coal Creek (Coal Creek)	1,151	57
Caballo West (Caballo)	777	88
Maysdorf II (Cordero Rojo)	4,654	434
North Hilight Field (Black Thunder) South Hilight Field (Black Thunder)	4590	588
West Hilight Field (Black Thunder)	2,371	440
West Jacobs Ranch (Jacobs Ranch)	5,944	957
North Porcupine (North Antelope Rochelle)[2] South Porcupine (North Antelope Rochelle)[2]	5,117	598
Hay Creek II (Buckskin)[2]	1,447	148
Total	31,739	3940
Source: BLM 2012k		

[1] The West Antelope II North tract was offered for lease May 2011– an adequate bid was received
[2] Application subsequently modified.

LBA Lease by Application

Coal leased in the planning area using the LBA process must conform to the Buffalo RMP. If the application is determined to conform, the applicant must supply detailed environmental and coal resource information before the BLM addresses the application. The BLM then completes two separate but concurrent evaluations of the application before a lease is offered for competitive sale.

Detailed coal data is necessary prior to processing a lease by application. Coal exploration on federal coal requires an exploration license from the BLM. The BLM reviews exploration programs to ensure they will provide sufficient data to meet adequacy standards for leasing. Licenses are issued after a site inspection, an environmental analysis to consider the impacts of exploration, and public notice inviting other interested parties to participate in the exploration program. Licenses are conditioned as necessary to mitigate impacts. Licensees post a bond to ensure damages and disturbances are repaired. Exploration data are considered confidential and are available only to the BLM, the licensee, and any participating parties. The Powder River Basin is the most actively explored federal coal region. This area accounts for as many open licenses and newly issued licenses as the rest of BLM-administered lands nationwide. Table 3.18, "Coal Exploration Licenses" (p. 266) lists recent license activity.

Table 3.18. Coal Exploration Licenses

Year	New Licenses	Open Licenses
2003	2	6
2004	2	4
2005	5	6
2006	4	8
2007	3	7
2008	1	10
2009	2	6
Source: BLM 2013a		

All actions and evaluations of coal lease applications must use data that meets or exceeds the Powder River Basin coal region data adequacy standards. This includes environmental and geological data standards.

All lease applications undergo an environmental analysis with full public involvement, including public scoping, completion of an EA or EIS, a public hearing, issuance of a decision and an appeal period.

All lease applications also undergo an analysis to determine fair market value, including the BLM determining in-place reserve; determining an optimum mine plan; determining mining costs, revenues, and net present value; accepting and considering fair market value comments at a public hearing; determining an adjusted comparable sale from other valid sales; preparing a sealed pre-sale estimate; and evaluating bids after the sale before accepting any bid.

In addition, lease tracts in response to a lease application are configured by the BLM to achieve maximum economic recovery and to promote competition. To ensure this, the BLM establishes a study area to encompass all reasonable economic reserves, requires geologic data to meet or exceed data adequacy standards for the study area, and considers maximum economic recovery comments at a public hearing. The BLM independently delineates the sale tract to be offered.

All leases are offered competitively by sealed bid, and successful lease tract bonus bids must meet or exceed fair market value as established by the BLM.

Existing leases can be modified, and reserves and acreage added. The process is similar to LBA, with a limit on the amount of acreage that can be added and the requirement that the BLM find the coal added to be non-competitive. Lease modifications are offered to the existing lessee at the presale fair market value as determined by the BLM.

A federal coal lease conveys the right to explore, develop, and remove the coal leased. The BLM offers coal leases on a deferred-bonus basis. Sealed bids are accepted before the lease sale. The successful high bidder (lessee) is required to submit the first installment, representing 20% of the total bid, with their bid before the lease sale. The balance of the bid is paid in equal annual installments on the next four anniversary dates of the lease. The lessee must pay the bonus bid in the first 5 years in equal annual payments. Since the mining in this planning area is surface mining, the lessee must pay a royalty of 12.5% of the sale value of coal severed and sold (underground mine leases have an 8% royalty rate). The lessee must comply with the requirements of the Mineral Leasing Act, the Surface Mining Control and Reclamation Act (SMCRA), any relevant state and federal laws, and the terms and conditions of the lease. The lessee has 10 years to achieve diligent development (produce 1% of the recoverable reserve as established by the BLM) and must maintain continued operations in each subsequent year (continue to produce 1% per year). Advanced royalty may be paid in lieu of continued operations for up to 10 years during the initial 20-year term of the lease. The BLM currently requires the lessee to post an annual bond to cover 25% of their annual estimated royalty, and 100% of annual rental. The BLM also requires a bonus bond unless the lessee requests a waiver and has maintained their payments to the Office of Natural Resources Revenue (ONRR) in good standing. A reclamation bond is required at the time the lease is permitted for mining. That bond amount is established by the Wyoming DEQ.

Mining operations are permitted under the authority of the SMCRA. A different DOI agency than the BLM, the Office of Surface Mining Reclamation Enforcement (OSM), has authority under the SMCRA. Before mining may commence on a federal lease, the DOI Assistant Secretary must approve a mine plan. For mine plan approval on a federal lease, the OSM requires a mine and reclamation plan prepared by the lessee; a State Decision Document from the Wyoming DEQ Land Quality Division approving the mine and reclamation plan under SMCRA requirements; a Resource Recovery and Protection Plan approved by the BLM establishing the recoverable reserve on the lease, mining limits, and recovery methods; and the BLM findings that the mine and reclamation plan complies with the Mineral Leasing Act; an EA or EIS prepared by the OSM as lead agency for compliance under NEPA for the mine plan approval; concurrence from any federal surface management agency to implement the mine and reclamation plan on surface they administer; and compliance with the Endangered Species Act, the National Historic Preservation Act, and any other applicable federal law.

Coal Exchanges

Coal is a public commodity that lends itself to use for exchanges in the public interest. Coal reserves can be accurately measured and tested, and have considerable value. A lease exchange is authorized either by special acts of Congress or under the authority of the SMCRA for alluvial valley floors designated critical to farming. An exchange results when coal lease rights on lands for which Congress has deemed coal mining an undesirable use are exchanged for equal valued lease rights in an area acceptable for further consideration for coal leasing. An exchange requires a NEPA analysis, an appraisal of value, and a finding that the exchange is in the public interest. Several lease exchanges were completed under the Interstate 90 Lease Exchange Act to eliminate coal lease rights under the routing of Interstate 90, and a recent lease exchange to eliminate the lease rights on an alluvial valley floor called Gold Mine Draw.

Coal Lease Management

The BLM administers coal leases. Lease administration includes setting lease bonds, lease readjustment, relinquishment, assignment, advance royalty, and royalty rate reductions. The lessee is required to produce commercial quantities (1% of the established reserve) annually from each lease, starting before the tenth year after lease issuance. Annual production is monitored to verify that each lessee is meeting diligent development and continued operations. The BLM inspects active leases at least every 3 months and inactive leases annually to determine and enforce compliance with lease terms and conditions. Any coal trespass is resolved under trespass rules. The BLM verifies production and attainment of maximum economic recovery on producing leases every 3 months. Reported production is compared to independently calculated production based on survey data. Any irregularities are reported to the Office of Natural Resources Revenue formerly the Minerals Management Service. Reported production during the 3-month period is compared to the coal volume mined during the 3-month period to determine the effectiveness of recovery practices and to verify the lessee is recovering coal consistent with the recoverable reserves available.

3.2.2.4. Trends

The BLM reviewed projected development activity and related environmental and social effects for the Powder River Basin. The *Powder River Basin Coal Review* (ENSR 2005b) projected development activity in 5-year increments to 2020. The review is complete and is available on the BLM website. The BLM is now working on extending the review to 2030, and these reports will be available as completed.

The lands determined acceptable for consideration for coal leasing under the coal screening performed for the April 2001 updated description of existing management were estimated to contain about 26 billion tons of coal reserves. Since 1985, about 10 billion tons have either been leased or are under consideration for leasing. Coal reserve demand has been projected to 2020 in the Task 2 report for the *Powder River Basin Coal Review*, and can be met within the lands currently screened and acceptable.

Coal forecasts for the Powder River Basin through 2020 indicate total production is expected to grow at an annual rate of 2 to 3%, consistent with electric power demand. It is expected that interest and demand for new leasing will continue through 2020 based on forecasting. The preliminary work for the 2030 forecast indicates a slower rate of increase in Powder River Basin coal demand, primarily due to new natural gas discoveries, a greater national priority given to nuclear and renewable energy generation, and potential impacts to coal-fired electric generation from possible regulation of greenhouse gases. A more realistic annual growth rate in Powder River Basin coal production through 2030 is between 0.25 and 2%. This forecast is consistent with the Energy Information Administration 2010 Energy Outlook Report (Energy Information Administration 2010). Therefore, by 2030 the BLM expects Powder River Basin coal production to be between 500 and 700 million tons annually.

3.2.2.5. Key Features

Key features are the high coal development potential areas.

3.2.3. Leasable Minerals – Fluids

Oil and gas resources are often found in the pore spaces of sedimentary rocks such as sandstone and limestone, having migrated there from source rocks rich in organic material, such as marine shales. When rocks containing organic material are subjected to heat and pressure, the organic compounds break down over time, resulting in oil and natural gas. As the oil and gas are generated, they migrate through the pore spaces of the rock or along fractures until they encounter a structural or stratigraphic trap with an impermeable layer. Another mode of occurrence for natural gas is CBNG, where the gas is trapped in the coal where it was generated. A well-known hazard in coal mines, CBNG has become economically important with some of the largest reserves found in the Powder River Basin.

3.2.3.1. Regional Context

The Powder River Basin is an area of 14 million acres in northeastern Wyoming and southeastern Montana that is roughly bounded by the Big Horn Mountains in the west, the Black Hills in the east, the Miles City Arch in the north, and Wyoming's Laramie Mountains, Casper Arch, and Hartville Uplift in the South. It is managed by four BLM offices in two states; the Buffalo Field Office, the Casper Field Office, and the Newcastle Field Office in Wyoming, and the Miles City Field Office in Montana.

Oil: Wyoming ranks seventh in the United States in the production of oil. Collectively in Wyoming, more than 38,000 wells produced 52.9 million barrels of oil in 2006. In the three counties in the planning area, approximately 9.8 million barrels of oil were produced in 2007.

Natural gas: Wyoming ranks second in the United States in the production of natural gas. Collectively in Wyoming, more than 38,000 wells produced 2.11 trillion cubic feet of natural gas in 2006. In the three counties in the planning area, approximately 13.2 billion cubic feet were produced in 2007.

Coalbed Natural Gas: The Powder River Basin CBNG field ranks eleventh in proven gas reserves in the United States (DOE 2008). Proven reserves are (1) the portion of an oil or gas reservoir delineated by drilling and defined by oil/water, gas/oil/water, or gas/water contacts, if any, and (2) the immediately adjoining portions not yet drilled, but that can be reasonably judged as economically productive based on available geologic and engineering data. In the planning area, the Powder River Basin CBNG covers portions of Campbell, Johnson, and Sheridan counties. Map 18 depicts the CBNG potential in the planning area. Collectively in the three counties in the planning area, approximately 429 billion cubic feet of CBNG were produced in 2007.

3.2.3.2. Indicators

The planning area has very few surface geologic structures (anticlines, faulted anticlines, and domes), which was the most successful method of discovering new reservoirs in Wyoming through the earliest periods of exploration. Most of the oil and gas fields have been and continue to be found using subsurface geologic techniques. These techniques mostly involve 2D seismic and more recently 3D seismic. The data from the seismic reveals the structures underground that may hold the fluid minerals. This data is then used to develop an exploratory drilling program to verify the data.

Another leasable mineral in the Buffalo planning area with some potential for development is geothermal energy. Geothermal energy is not being developed in the Buffalo planning area at this time, and it is not likely to be developed during the planning period.

3.2.3.3. Current Condition

There were few documented test wells drilled until the mid 1900s, when subsurface geologic techniques and acquisition of seismic reflection data began to be employed in Wyoming. The first oil field discovered in the planning area was Billy Creek in 1923. The Adon and Sussex fields were discovered in 1948, and the North Tisdale field in 1952. More fields have since been discovered and developed. Conventional (non-CBNG) fields in the planning area most often are considered to be stratigraphic traps, but structural and combination structural/stratigraphic trap types are also common. Most fields are considered to be oil fields. Gas fields were rarely discovered in the planning area until CBNG exploration began in recent years. The RFD provides a more detailed description and history of oil and gas development in the Buffalo planning area (Stilwell et al. 2012).

Exploration

Oil and gas reservoirs can be discovered by direct or indirect exploration methods. Direct methods include mapping of surface geology, observing seeps, and gathering information on hydrocarbon shows observed in drilling wells. Indirect methods, such as gravity, magnetic, and seismic surveys, are used to delineate subsurface features that could contain oil and gas that are not directly observable. The petroleum industry utilizes two-dimensional and three-dimensional seismic technology to gather subsurface stratigraphic information to aid in the search for oil and gas reserves. Seismic technology utilizes explosives in drilled shot holes for source points along linear survey lines and vibroseis or shaker trucks and buggies for source points in a grid pattern over a large area that can cover hundreds of square miles.

Leasing and Production

The BLM reviews and approves Notices of Intent, applications for permits to drill (APDs), and applications from companies to lease, explore, develop, and produce oil, gas, and geothermal resources on federal lands. The BLM also is responsible for inspection and enforcement of oil, gas, and geothermal wells and other development operations, to ensure that lessees and operators comply with lease requirements and BLM regulations.

The main objectives of the oil and gas program are to foster a fair return to the public for its resources, ensure environmentally acceptable activities within the program, and provide for conservation of the fluid mineral resources without compromising the long-term health and diversity of the land. BLM management of the oil and gas program accomplishes several functions in support of the main objectives, including: (1) supporting the domestic need for energy resources, (2) making eligible lands available for leasing through proper planning, (3) timely processing of applications and notices for exploration and development, and (4) inspecting operations and ensuring compliance with lease terms and regulations.

As of October 1, 2008, federal oil and gas leases covered approximately 2,533,975 acres in the planning area (Map 12) (BLM 2008g). Table 3.19, "Number of Oil and Gas Leases by County in the Planning Area" (p. 271) lists the number of leases and total number of acres under lease by county in the planning area. Federal mineral estate in coal-bearing areas of the Powder River Basin has not been offered for lease since 2004 as a result of a Tenth Circuit Court of Appeals ruling (*Pennaco Energy v. Department of the Interior*, 377 F.3d 1147). Oil and gas leasing within coal bearing areas is being analyzed in this RMP revision, and leasing will resume on completion of the RMP revision if oil and gas leasing is determined to be an appropriate use within the planning area.

Due to No Surface Occupancy (NSO) restrictions, three areas in the Buffalo planning area are not open to leasable mineral development (unless those activities cause no surface disturbance) – the Fortification Creek WSA in northeastern Johnson County and northwestern Campbell County, and the Gardner Mountain and North Fork WSAs in southwestern Johnson County in the southern Big Horn Mountains. Three other areas are not open to mineral location (and also not open to leasable mineral development due to their NSO restrictions), because they have been officially withdrawn through Congressional Acts from such activities – Amsden Creek Big Game Winter Range in Sheridan County, part of the Ed O. Taylor Big Game Winter Range in Johnson and Washakie counties, and part of the Kerns Big Game Winter Range in Sheridan County.

Table 3.19. Number of Oil and Gas Leases by County in the Planning Area

County	Number of Leases	Acres Under Lease
Campbell	3,149	1,428,517
Johnson	1,092	803,511
Sheridan	255	301,947
Source: BLM 2008f		

Table 3.20, "Well Statistics for Campbell, Johnson, and Sheridan Counties, November 2008" (p. 272) lists well statistics for the planning area. After the BLM approves an APD on federal oil and gas leases, the developing company may proceed with drilling in accordance with applicable regulations, Onshore Oil and Gas Orders, Notices to Lessees, lease terms and conditions, and the approved APD (with the conditions of approval attached to the permit).

Table 3.20. Well Statistics for Campbell, Johnson, and Sheridan Counties, November 2008

	Federal	Fee or State	Total
Campbell County			
Number of Plugged and Abandoned Wells	3,911	5,236	9,147
Number of Dormant Wells	105	136	241
Number of Completed Wells	7,582	12,085	19,667
Number of Monitoring Wells	11	23	34
Notice of Intent to Abandon	204	415	619
Number of Spuds	385	513	898
Number of Expired Permits	9,079	8,825	17,904
Number of Permits To Drill	1,349	480	1,829
Permits Issued (Total of all the above)	22,626	27,713	50,339
Total (Permits Issued and Waiting on Approval)	22,653	27,729	50,382
Johnson County			
Number of Plugged and Abandoned Wells	1,000	698	1,698
Number of Dormant Wells	95	14	109
Number of Completed Wells	2,995	1,745	4,740
Number of Monitoring Wells	17	9	26
Notice of Intent to Abandon	34	39	73
Number of Spuds	219	113	332
Number of Expired Permits	4,075	2,854	6,929
Number of Permits To Drill	875	226	1,101
Permits Issued (Total of all the above)	9,310	5,698	15,008
Waiting On Approval	19	16	35
Total (Permits Issued and Waiting on Approval)	9,329	5,714	15,043
Sheridan County			
Number of Plugged and Abandoned Wells	104	366	470
Number of Dormant Wells	0	9	9
Number of Completed Wells	457	3,976	4,433
Number of Monitoring Wells	6	13	19
Notice of Intent to Abandon	2	91	93
Number of Spuds	18	125	143
Number of Expired Permits	1,187	4,631	5,818
Number of Permits To Drill	173	200	373
Permits Issued (Total of all the above)	1,947	9,411	11,358
Waiting On Approval	13	22	35
Total (Permits Issued and Waiting on Approval)	1,960	9,433	11,393
Source: WOGCC 2008			

Geothermal Energy

Geothermal energy is energy derived from the natural heat of the earth. Typically, geothermal resources consist of underground reservoirs of hot water and steam; subsurface areas of dry hot rock also occur, although more rarely (BLM 2008d, p. 1 to 3, 1 to 9). Geothermal reservoirs can have temperatures well over 450 °F (235 °C), and can be found at various depths below Earth's surface (BLM 2008d, p. 1 to 3). Often, it is either the temperature or depth of a geothermal resource that can determine whether it might be viable to develop; both hotter resources and resources closer to the surface are more likely to be developed for their geothermal energy. Although the potential for geothermal development is defined as heat flow above 140 °F (60 °C) (BLM 2008d, p. 1 to 1), geothermal resources of lower temperatures are also utilized.

A geothermal lease is for the Earth's heat resources where there is federal mineral estate (BLM 2008d, p. 1 to 10). The BLM has the delegated authority to issue geothermal leases on federal mineral estate, including those underlying lands whose surface is administered by the USFS (BLM 2008d, p. ES-1). See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) or contact the Buffalo Field Office for more detailed information regarding mineral leasing.

Geothermal steam and hot water often naturally reach Earth's surface due to the often high subsurface pressures created by the hot steam and hot water. Hot springs, geysers, mud pots, and steam vents all result from hot water and steam that are under pressure and reach the surface (BLM 2008d, p. 1 to 3); typical examples of these features can be seen in Yellowstone National Park, Wyoming. Hot water and steam often can be directly used for their heat energy. However, the heat energy of dry hot rock reservoirs often is captured by injecting cool water, allowing the water to absorb heat from the rock, with extraction as either hot fluid or steam (BLM 2008d, p. 1 to 3). The cooled water is disposed of either on the surface, or injected back into the geothermal reservoir to be reheated for capturing more heat energy (BLM 2008d, p. 1 to 4). Some geothermal resources are deficient in water and permeability, but can be enhanced to increase their productivity. These are called enhanced geothermal reservoirs, and treatments involve increasing the size and connectivity of the rock fractures, allowing the hot water or steam to more easily move through the rock (BLM 2008d, p. 1 to 10).

Geothermal resources are often accessed by wells, with the extracted heat energy being directly used as heat energy, or indirectly used to generate steam to produce electricity (BLM 2008d, p. 1 to 3 and 1 to 10). Today, geothermal reservoirs of low- to moderate-temperature water (68 °F to 302 °F [20 °C to 150 °C]) provide numerous opportunities for direct and indirect use (BLM 2008d, p. 1 to 4 to 1 to 8); those with even higher temperatures are often used only for indirect use (BLM 2008d, p. 1 to 4 and 1 to 10). Some direct uses of geothermal resources are heating pools, spas, greenhouses, aquaculture facilities, and buildings; melting snow on sidewalks and driveways; and drying agricultural products. Direct use applications in the United States have been growing at about 6% per year (BLM 2008d, p. 1 to 4). These lower-temperature resources are fairly abundant throughout the western United States; a recent survey of 10 western states identified more than 9,000 geothermal wells and springs, more than 900 low- to moderate-temperature geothermal resource areas, and hundreds of direct-use sites (BLM 2008d, p. 1 to 4). In general, indirect use for commercial electrical generation requires geothermal reservoirs with temperatures above 200 °F (93 °C), although newer technologies can utilize lower temperatures (as low as 165 °F [74 °C]) (BLM 2008d, p. 1 to 6 and 1 to 8).

A number of publications (e.g., Williams et al. 2008 (2008); DOE 2006; National Oceanic and Atmospheric Administration 1983) state that the Powder River Basin has potential for the occurrence of geothermal resources. The potential for the existence of low-temperature geothermal resources (less than 212 °F [100 °C]) has been rated "good" (DOE 2006), and for moderate- to high-temperature geothermal resources, "low" (Williams et al. 2008). However, to date there has been very limited geothermal exploration; almost all existing information about subsurface temperatures in the planning area consist of bottom-hole temperatures of oil and gas wells (Williams et al. 2008; DOE 2006; National Oceanic and Atmospheric Administration 1983). This data suggest that the basin (including the western edge near the Big Horn Mountains and northeastern edge near the Black Hills) might be overall too cool to provide the temperatures needed for geothermal development, except at excessive depths. Development of this resource could either be too costly to be economically feasible or require technologies not yet in existence. The level of this resource remains largely unknown (Williams et al. 2008; DOE 2006), and only with further exploration will the level of this resource become more fully understood.

3.2.3.4. Trends

The earliest recorded test well in the planning area was drilled in 1886 on the Tisdale Structure (Biggs and Espach 1960). From 1902 to 1923 there were at least 30 conventional wells that are known to have been drilled and abandoned. The Billy Creek Field was discovered in 1923. The next field discoveries were in the Adon and Sussex Fields in 1948. In 1952 the North Tisdale Field was discovered. In 1960 the amount of drilling increased reaching a peak in 1969 with 779 conventional wells drilled. The drilling then declined until 1973. From 1974 to 1984 there was a small increase with the peak in 1977 with 405 wells drilled. From 1984 to 1995 drilling decreased to it historical lows. In 1995 and 1996 there was a slight increase in drilling, but since then drilling has occurred at a rate of less than 100 new wells per year with 2007 and 2008 averaging 40 new wells a year. This is expected to continue into the future with possibly a slight increase. Beginning in 2009 horizontally drilled wells began increasing and are forecasted to be the main type of conventional drilling in this planning period.

The earliest suspected CBNG well occurred in 1916, perhaps earlier (DeBruin and Jones 1989). However, there was very little interest in CBNG prior to 1987. There were only 12 wells specifically targeting CBNG prior to 1987 with the first modern well drilled in 1979. From 1987 to 1998 drilling increased from 19 new wells in 1987 to 653 new wells in 1998. There were 1,642 wells drilled during this time period. Starting in 1999 a rapid increase in the number of CBNG wells drilled began. A method called “blanket drilling” was the dominant method of drilling. This resulted in 2507 wells drilled in 1999, more than were drilled in all previous years combined. A gradual change from blanket drilling should be expected in the next five to ten years as development will become more localized and require more geologic and engineering analysis.

There is geothermal energy in the Buffalo planning area; however, the known depths at which the required temperatures exist are too great to make this area an attractive target for current exploration. There are economically viable geothermal energy resources in many areas outside the planning area. With future technological advancements, this resource could become more viable to pursue in the planning area. However, this is not likely during the planning period given the current state of technology.

3.2.3.5. Key Features

Key features for conventional oil and gas development include oil seeps to surface, mapping of surface and subsurface geologic structures, and exploratory drilling to define the limits of the fields. For CBNG the key feature is drilling within the outcrops of the coal bearing formations. Key features for geothermal energy would include hot springs at the surface or geothermal vents of which there are none in the planning area.

3.2.4. Leasable Minerals – Other

The leasable mineral resources currently being developed in the planning area are coal, crude oil, and natural gas. Although geothermal energy occurs in the planning area, the depths of occurrence for temperatures useful for many commercial applications make it uneconomic to develop currently, or in the near future given the state of technology and market trends. Coal, oil and gas, and geothermal energy are discussed separately in the subsections above. Although leasable minerals other than these ("other leasable minerals") are known to occur in the planning area (e.g., potassium, sodium, and phosphate), none of these are known to exist in commercially viable quantities, and this situation is not likely to change during the planning period given market trends.

3.2.4.1. Regional Context

A number of other leasable minerals (e.g., trona, oil shale, and tar sands) are under development in other parts of Wyoming and the western United States.

3.2.4.2. Indicators

As discussed under *Current Condition* below, no other leasable minerals are known to occur in the planning area in quantities sufficient for commercial production. There have never been any requests submitted for leasing of other leasable minerals in the planning area, and this is not likely to change during the planning period.

3.2.4.3. Current Condition

Other leasable minerals, as used in this document, are leasable minerals other than coal, crude oil, natural gas, and geothermal energy. Other leasable minerals in the planning area include potassium, sodium, and phosphate. However, from well logs, well cores, and other information, no other leasable minerals are known to exist in the planning area in commercially viable quantities. There is no history of the development of (or requests for the leasing of) other leasable minerals in the planning area; this is not likely to change during the planning period.

3.2.4.4. Trends

The current situation in the planning area regarding other leasable minerals is not likely to change during the planning period. Therefore, these resources are not discussed further in this chapter, and are not analyzed in Chapter 4.

3.2.4.5. Key Features

There are no known other leasable minerals in the planning area in quantities sufficient for commercial production.

3.2.5. Salable Minerals

3.2.5.1. Regional Context

The main salable minerals (also called mineral materials) developed in Wyoming are aggregate (e.g., sand, gravel, and rip rap), building stone, common clay, decorative stone (including moss rock), clinker (or porcellanite, locally called "scoria"), and soil. The salable minerals currently being developed for commercial purposes in the planning area are aggregate (sand, gravel, and rip rap), scoria, building stone, and decorative stone.

3.2.5.2. Indicators

Indicators used to describe resource condition and assess the status of the salable minerals resources in the planning area include currently known quantities (including both actual known and estimated quantities), historic and forecasted demand, and historic and forecasted production. Often there is a production time lag: it takes time for mines to increase production to meet an increase in demand, or for planned mines to come into production. Therefore, previously stockpiled amounts can be quickly depleted when demand increases quickly.

Changes in prices (actual and forecasted) over time for these resources also could be indicators. However, because a change in commodity price often drives changes in supply and/or demand for that commodity, the changes in production and/or demand over time often closely mirror or parallel price changes. Price changes are usually more volatile, occurring much more quickly and frequently, than changes in demand or production, and can occur for numerous reasons possibly unrelated to the commodity itself. Therefore, price changes are not addressed here.

Additionally, changes in price and/or demand for a particular commodity (either increases or decreases) can lead to additional materials being introduced into the market as suppliers attempt to remain economically solvent. This factor, the introduction of substitute materials into the marketplace, often makes the accurate predictions of demand, supply, and price for individual minerals extremely difficult, both in the short and long term. Use of substitute materials can be quite common for industrial minerals, even for relatively common and abundant ones as sand, gravel, and scoria.

The levels of mineral exploration and development activities, and the areas where they take place, are integrally linked to supply and demand for these commodities. This often involves local, national, and international economics and politics, and is therefore difficult to predict on the scale of the planning area. Note also that societal, political, and economic priorities, decisions, and events can affect salable minerals activities through increases or decreases in exploration and/or development activities, and where they occur. Conversely, increases or decreases in salable minerals activities could impact societal, political, and economic priorities, decisions, and events. As it is difficult to accurately predict future trends in mineral demand and production on the scale of the planning area, only the indicators quantity, demand, and production, and the trends they might reveal, are discussed here, and in relatively general terms.

3.2.5.3. Current Condition

Salable minerals are typically used in everyday construction, road building and repair, mining, agriculture, and decorative applications. Most of the federal salable minerals resource in the planning area occurs on split estate lands (usually private surface/federal minerals). Salable minerals are disposed of according to the *Materials Act of 1947* (as amended), and other laws and regulations. The regulations at 43 CFR 3600 outline the requirements for obtaining a sales contract for commercial operations or a free-use permit (FUP) for government entities or non-profit organizations. See Chapter 2 or the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information.

Unless closed to salable minerals activities, all federal lands in the planning area (including federally administered surface/federal minerals and split estate) are open to the exploration and development of salable minerals. To explore for salable minerals (excluding casual use), a letter of authorization is required. To develop a salable minerals deposit, a mining and reclamation plan is required. Mining/reclamation plans and reclamation bonding requirements are developed in cooperation with the State of Wyoming DEQ LQD. All salable minerals projects are reviewed to ensure that no undue or unnecessary degradation would occur, and for compliance with bonding policy for reclamation after cessation of project activities.

Three areas in the planning area are not open to salable minerals activities, as they are under review by Congress for formal designation as Wilderness Study Areas (WSAs). These areas also are currently restricted from leasable mineral activities, unless such activities (salable or leasable minerals activities) would not impair the areas' suitability conditions for designation as wilderness. If Congress acts to have any of these areas formally designated as a WSA, then the restriction on salable minerals activities for that area will become a permanent prohibition. If Congress denies formal designation for any of these areas, then that area will then become open again to salable minerals activities, although management of the area would likely include requirements to maintain much of the areas' unique features. The BLM recommendation for all three areas is to not become wilderness. See *Special Designations – WSAs* for more information. These three areas are (see Map 63):

- Fortification Creek WSA – This area consists of 12,419 acres of BLM-administered surface/federal mineral lands in northeastern Johnson and northwestern Campbell counties. Clinker (scoria) is the only salable mineral known to occur in commercial quantities in this area, and adequate quantities are available outside its boundaries.
- Gardner Mountain WSA – This area consists of 6,423 acres of BLM-administered surface/federal mineral lands in southwestern Johnson County. Moss rock and building stone are the only salable minerals known to occur in commercial quantities in this area, and adequate quantities of each are available outside its boundaries.
- North Fork WSA – This area consists of 10,089 acres of BLM-administered surface/federal mineral lands in southwestern Johnson County. Moss rock and building stone are the only salable minerals known to occur in commercial quantities in this area, and adequate quantities of each are available outside its boundaries.

Those salable minerals useful for road construction and maintenance (sand, gravel, clinker [scoria], and for certain situations rip rap) are in greatest demand in the planning area. Most scoria in the planning area is used by the coal mines near Gillette to keep their haul roads passable. They need large volumes of mineral materials for this, and scoria is relatively abundant in and near the coal mine areas, while sand and gravel are much less abundant in those areas. Sand and gravel are used mostly for oil and gas development, general construction purposes, and non-mine road surfacing and maintenance (highways, county roads, etc.). Building and decorative stone (including flagstone and moss rock) and other mineral materials have typically experienced much less demand from public lands in the planning area than sand, gravel, and scoria. Disposals of these materials are typically small (fewer than 5 tons), although occasionally a larger sale has been requested. There is one Common Use Area (CUA) (comprised of seven collecting areas scattered across Johnson County) in the planning area, and currently all moss rock and flagstone sales from public lands occur from the CUA. Because the demand for and production of these mineral materials from public lands in the planning area are typically very low (especially as compared to that of sand, gravel, and scoria, they are only briefly addressed below. For the same reason (typically very low volumes), they are not addressed or analyzed in Chapter 4. See the *Mineral Occurrence and Development Potential Report* (BLM 2009c) or Chapter 2 of this RMP for more information regarding these mineral materials.

Sand and gravel are typically the same substance: fragments or particles of rock, but of different sizes. In addition, they more often occur as mixed deposits (mixed sand and gravel), rather than just one or the other. Most importantly, they are used for generally the same purposes in the planning area. For these reasons, they are not discussed or treated separately in this chapter, nor are they separately addressed and analyzed in Chapter 4. Scoria, though, is a very different material from sand and gravel. However, all three of these materials are typically used for nearly the same purposes in the planning area. Therefore, scoria is not discussed or treated separately from sand and gravel and is not addressed and analyzed separately in Chapter 4. Table 3.21, “Current Authorized Salable Mineral (Mineral Materials) Disposals in the Buffalo Planning Area” (p. 278) lists the current authorized disposals (both contracted sales and FUPs) for salable minerals (mineral materials) in the planning area. Note that the table lists only sand and gravel and scoria disposals. The Buffalo planning area has the greatest number of mineral material sales and FUPs of any field office in Wyoming.

Table 3.21. Current Authorized Salable Mineral (Mineral Materials) Disposals in the Buffalo Planning Area

Operator	Legal Description
Hilcorp Energy (s&g, ct)[1]	T. 41 N., R. 81 W., Section 4, NENENE
Basic Energy (s&g, ct)	T. 42 N., R. 76 W., Section 11, NENW
Sierra Construction (sc, ct)	T. 42 N., R. 78 W., Section 12, SENWSE
Dan Hart Patrol (s&g, ct)	T. 43 N., R. 73 W., Section 18, NWNE
Lone Hart, LLC (s&g, ct)	T. 43 N., R. 77 W., Section 3, SWSE
Cole Lumber (s&g, ct)	T. 43 N., R. 77 W., Section 3, S2SWNW
Johnson County (s&g, fup)	T. 43 N., R. 79 W., Section 3, E2NWSE, W2NESE
Sussex Sand & Gravel (s&g, ct)	T. 43 N., R. 79 W., Section 3, NESESE, SENESE
Johnson County (s&g, fup)[1]	T. 43 N., R. 79 W., Section 9, NENE
Bell’s Restoration (s&g, ct)	T. 44 N., R. 73 W., Section 5, NWNW
Johnson County (s&g, fup)	T. 44 N., R. 78 W., Section 18, NWSENE of Lot 16, W2NE, SWNENE
Campbell County (sc, fup)	T. 45 N., R. 70 W., Section 4, NWSWSE
First Energy (s&g, ct)	T. 45 N., R. 73 W., Section 11, SWSWSE
Campbell County (s&g, fup)	T. 45 N., R. 73 W., Section 11, S2NESE, N2NESE
Johnson County (s&g, fup)[1]	T. 45 N., R. 84 W., Section 26, N2SESE
Dull Knife Dirtwork (s&g, ct)[1]	T. 46 N., R. 85 W., Section 10, SWNW, NWSW
Johnson County (s&g, fup)	T. 46 N., R. 85 W., Section 15, SWNE, SENE
Caballo Rojo (sc, ct)	T. 47 N., R. 71 W., Section 2, Lots 7 & 10
Cordero Rojo (sc, ct)	T. 47 N., R. 71 W., Section 13, E2NE, NENE, N2SE, SESE
First Energy (s&g, ct)	T. 47 N., R. 78 W., Section 1, NENENE
Johnson County (s&g, fup)	T. 47 N., R. 85 W., Section 23, S2NWNWSE
Washakie County (s&g, fup)[1]	T. 47 N., R. 85 W., Section 33, N2NESENE
Johnson County (s&g, fup)[1]	T. 47 N., R. 85 W., Section 33, E2SWNWNW
Powder River Coal (sc, ct)	T. 48 N., R. 71 W., Section 26, W2 of Lot 2, E2 of Lot 3, Lots 6 & 7

Operator	Legal Description
Alpha Coal West (sc, ct)	T. 48 N., R. 71 W., Section 34, Lot 4, SE of Lot 11
Hettinger Welding (sc, ct)	T. 48 N., R. 72 W., Section 27, Lot 13, Section 34, Lot 4
Magna Energy (s&g, ct)	T. 48 N., R. 77 W., Section 7, NESW
Johnson County (s&g, fup)[1]	T. 48 N., R. 77 W., Section 7, SESW
Johnson County (s&g, fup)	T. 48 N., R. 81 W., Section 23, NESW
Johnson County (s&g, fup)[1]	T. 48 N., R. 81 W., Section 25, SENWNE
Johnson County (s&g, fup)	T. 49 N., R. 81 W., Section 4, W2SENW
Campbell County (s&g, fup)	T. 49 N., R. 81 W., Section 5, W2 of Lot 2, NE of Lot 3
City of Buffalo (s&g, fup)	T. 49 N., R. 82 W., Section 3, S2SE
Eldridge Excavating (sc, ct)	T. 50 N., R. 73 W., Section 14, NESE
Hettinger Welding (sc, ct)	T. 50 N., R. 73 W., Section 30, E2SESW
Melgaard Construction (s&g, ct)[1]	T. 50 N., R. 77 W., Section 7, NWNW
Earth Work Solutions (s&g, ct)	T. 50 N., R. 79 W., Section 19, SWNE
Johnson County (s&g, fup)[1]	T. 50 N., R. 82 W., Section 30, SENWNE
Campbell County (sc, fup)	T. 51 N., R. 71 W., Section 34, NWSE
Alpha Coal West (sc, ct)	T. 51 N., R. 72 W., Section 18, SESW
Hettinger Welding (s&g, ct)	T. 51 N., R. 80 W., Section 29, NW of Tr 88
Basic Energy (s&g, ct)	T. 51 N., R. 80 W., Section 32, SW of Tr 88
Wyoming Red Rock (sc, ct)	T. 52 N., R. 72 W., Section 2, W2SWNW
Twenty Mile, LLC (sc, ct)	T. 52 N., R. 75 W., Section 11, E2NESW
Magna Energy (sc, ct)	T. 55 N., R. 73 W., Section 1, S2 of Tr 39H
Sheridan County (sc, fup)	T. 55 N., R. 82 W., Section 20, W2NESWNE, E2NWSWNE
DCM Construction (sc, ct)	T. 55 N., R. 83 W., Section 22, S2NESW
Hettinger Welding (sc, ct)	T. 56 N., R 73 W., Section 8, SENWSW, NWSESW
Earth Work Solutions (sc, ct)	T. 57 N., R. 74 W., Section 18, SWSW
Wood Group (sc, ct)	T. 57 N., R. 75 W., Section 18, SWNESW, NWSESW
PG Ranch (sc, ct)	T. 57 N., R. 76 W., Section 22, NWNW
Bighorn Services (s&g, ct)	T. 57 N., R. 83 W., Section 6, W2, NENE of Lot 6
Pinnacle Gas Resources (sc, ct)	T. 58 N., R. 76 W., Section 27, SESW

Source: BLM 2008f

[1] BLM-administered surface/federal minerals. The remaining mines are on private surface/federal minerals

ct contract
E East
fup free-use permit
N North
R Range
s&g sand and gravel
S South
sc scoria
T Township
W West

3.2.5.4. Trends

Sand and gravel deposits tend to occur along major drainages throughout the planning area and along the eastern flank of the Big Horn Mountains, but can occur in more isolated deposits across nearly the entire planning area (Map 10). Although the areal extent of scoria in the planning area is fairly well known (Map 10), the thickness and quality of these rocks is not. The thickness and quality of sand and gravel and scoria deposits can often only be determined through exploration, usually by trenching and sometimes by drilling. Note that where sand and gravel and scoria deposits have been identified as occurring or likely to occur (Map 10) is not necessarily where they are likely to be mined. Such common, low-priced, bulk commodities are most likely to be developed near the point of use, where transportation costs are lowest. The demand for sand and gravel is moderate in the planning area, and the largest consumers have been oil and gas companies for use in development of those resources. Given the estimated areal extent of these deposits and somewhat lower demand for these minerals, it is very likely that there is enough sand and gravel in the planning area to meet local demand during the planning period. The demand for scoria in the planning area is high, and the coal mines along the eastern edge of the Powder River Basin are the main users of this mineral. Given the areal extent of scoria in the planning area (a total of 350 square miles), there is very likely enough to meet local demand during the planning period.

Building and decorative stone of various types also occurs in the planning area, but the demand for and production of these minerals is typically of a much lower volume than that for sand, gravel, and scoria. Due to low demand and production, trends for these minerals are not discussed. Moss rock consists of lichen-encrusted scoria, limestone, and sandstone. Moss rock occurs in various areas of often limited size and extent, scattered across the planning area. Flagstone is the main building stone of interest in the planning area, and this consists of light tan to reddish to purplish sandstone layers that tend to break into predominantly flat pieces. Flagstone outcrops typically occur along the edges of the Powder River Basin.

Table 3.22, “Authorized Volumes for Salable Mineral (Mineral Materials) Disposals in the Buffalo Planning Area” (p. 280) lists volumes for recent (2000 through 2010) authorized salable minerals (mineral materials) disposals; only for sand, gravel, and scoria, as discussed above. These disposal authorizations are separated into contracted sales to private entities and FUPs to government entities; no nonprofit organizations have requested free use of mineral materials in the planning area. All amounts authorized (cubic yards or tons) in each year for each type of mineral and by type of authorization are presented below as summations. Converting between cubic yards and tons is not always straightforward and there are a number of factors to consider; therefore, the table lists the volumes (cubic yards) and weights (tons) separately to maintain accuracy of reporting.

Table 3.22. Authorized Volumes for Salable Mineral (Mineral Materials) Disposals in the Buffalo Planning Area

Year	FUPs (cubic yards)	FUPs (tons)	Sales (cubic yards)	Sales (tons)
2000	60,000	57,500	745,100	6,450
2001	100,000	222,000	550,450	8,600
2002	60,000	182,000	897,250	18,000
2003	62,800	423,650	1,122,650	14,900
2004	37,000	121,500	881,100	107,200
2005	73,000	290,000	679,935	22,000
2006	30,000	275,000	698,650	158,000
2007	400,000	113,000	1,306,050	87,800
2008	45,000	100,500	950,000	50,000
2009	60,000	225,000	650,000	85,000
2010	58,000	185,000	800,450	65,000

Source: BLM 2008f

Note: The amounts listed in this table are the amounts that had been authorized to be produced, not actual produced amounts; actual production may have been less than the amounts authorized.

fup free-use permit

Demand for salable minerals nationwide has been increasing in recent years due to an increase in construction and general growth. However, this trend has slowed very recently due to the economic downturn beginning in late 2008, and the recently decreasing price for natural gas. Matching this trend, the BLM has seen a consistent increase in the amount of salable minerals sold and in the number of contracts and requests for contracts for salable minerals over recent years (Table 3.22, “Authorized Volumes for Salable Mineral (Mineral Materials) Disposals in the Buffalo Planning Area” (p. 280), above), with this trend starting to slow very recently. Scoria comprises the largest portion of the salable minerals mined in the planning area – approximately 75% of the amount (cubic yards plus tons) of all mineral materials disposals. Coal companies use most of the scoria mined in the planning area on their haul roads to allow year-round safe access in and around the coal mining areas; all from just 5 scoria mines. Private entities operate 13 scoria mines in the planning area. Most of these mines sell the scoria to CBNG and oil companies, mostly for use in local oil and gas development; 1 scoria mine provides materials solely for use on a very large ranch. Three scoria mines are operated by county governments via FUPs, and this material is used for county road maintenance. The demand for scoria should remain high into the future because coal production in the Powder River Basin is expected to grow 2 to 3% annually (see *Leasable Minerals – Coal*) and coal companies will continue to need scoria to maintain their haul roads. In addition, scoria is used in oil and gas development, which also is anticipated to continue at a good pace (see *Leasable Minerals – Fluid*).

Sand and gravel are mined in less substantial quantities, constituting approximately 25% of the amount (cubic yards plus tons) of all mineral materials disposals in the planning area. Private entities operate 16 sand and gravel mines for sales in the tri-county area to CBNG and oil companies for use in oil and gas development, and to construction companies for use in general construction purposes. Local counties operate 15, and a local city operates 1 sand and gravel mine. These agencies tend to use more sand and gravel for road maintenance than scoria, because scoria tends to break down more rapidly and often creates more dust than sand and gravel. Although sand and gravel production has decreased somewhat very recently as oil and gas development began to slow, production in the future will likely be at a lower volume than the current level, but is anticipated to be sufficient to meet demand.

The demand for building stone and moss rock is very low; these materials are typically sold in small quantities, 5 or fewer tons, from the Common Use Area’s small collecting areas in Johnson County to residents from across the planning area. This amount of demand is not likely to change over the planning period.

3.2.5.5. Key Features

The salable minerals being developed in the planning area tend to occur at or very near the surface (Map 10). As the prices of most of these minerals are relatively low, operators look for deposits that will have lower mining costs. This means that the deposits being explored for and developed either occur at the surface or have relatively thin overburden (the rock, sediment, and/or soil on top of a deposit and which needs to be removed prior to mining the deposit). The formations in which these minerals occur are summarized here; see *Geological Resources* or the *Mineral Occurrence and Development Potential Report* (BLM 2009c) for more information regarding these minerals.

Most aggregate (sand, gravel, and rip rap) in the planning area were derived from alluvial deposits consisting of detritus (eroded rocks) exposed in the Big Horn Mountains, or from other formations such as the Wasatch and Fort Union Formations in the Powder River Basin. Gravel deposits in the Kingsbury Conglomerate and Moncrief Members of the Wasatch Formation are especially predominant along the western and southern edges of the Powder River Basin. Aggregate from more eastern areas comes from other portions of the Wasatch and Fort Union Formations. A relatively small amount of aggregate is mined from stream beds. Clinker (locally called scoria) is reddish- to brownish-colored to black rock, that often breaks into thinnish slabs although some areas can be vesicular (bubbly-looking). It is the vesicular portions that gave rise to the local name of scoria, as these portions can look nearly identical to that volcanic rock. Scoria formed in the PRB when rocks and sediment overlying a coal seam were baked and/or melted as the coal seam burned. Scoria is found in the Wasatch and Fort Union Formations where coal seams had caught fire along their surface outcrops or exposures along river and stream courses. It is especially prominent in the Rochelle Hills east of the coal mines in eastern and northern Campbell County, as well as north-central and south-central Sheridan County, and north-central Johnson County near Lake DeSmet and east of Buffalo (Heffern and Coates 1997). Building and decorative stone of various types (including moss rock and flagstone) typically outcrop in localized areas, where these harder layers of sedimentary rock are exposed through erosion. Moss rock occurrences are usually limited in size and extent, and consists of lichen-encrusted scoria, limestone, dolomite, and sandstone. These are found in the Wasatch and Fort Union Formations, Madison Limestone, Bighorn Dolomite, and Lance Formation (respectively). Flagstone is the main building stone of interest in the planning area, and consists of light tan to reddish to purplish sandstone layers in the Lance Formation which tend to break into predominately flat pieces.

3.3. Fire and Fuels Management

The goals of fire management are to protect life and property; protect or enhance natural resources; and restore or maintain landscape-level fire regimes and associated vegetation characteristics. These goals are broadly defined through federal fire policy, with specific objectives identified in the local RMP.

There are two types of wildland fire: unplanned ignitions (wildfire), and planned ignitions (prescribed fire). Unplanned ignitions occur from an act of nature such as lightning, or from accidental or intentional human causes. Planned ignitions are management actions which are developed and implemented to meet resource and fire management objectives. With safety a priority, both types of fire are managed to achieve the objectives of this RMP whether those objectives are for protection or for resource benefit, or both.

Fire management on BLM-administered lands in the Buffalo Field Office planning area is guided by the goals and objectives in the 1985 RMP and 2001 RMP update, and is implemented by the current Wyoming High Plains District (WHPD) Fire Management Plan (FMP). Safety receives the highest priority in every situation and the costs of operations must be commensurate with the values being protected. To meet resource objectives in the RMP, fire and fuels management strategies are based on resource constraints, land and vegetation characteristics, fire histories, fire regime condition classes FRCC values at risk, and wildland urban or industrial interface areas.

Table 3.23, “Annual Average Acres of Planned and Unplanned Fires in Different Vegetative Types in the Planning Area from 1990 through 2007” (p. 283) lists the acres of planned and unplanned fires from 1990 to 2007 that have occurred in different vegetation types in the planning area. For unplanned fire the data include only fires in which BLM responded or assisted, and for planned fire the data are from BLM-administered projects. In both cases, land status may include mixed surface ownership.

A summary of the 18 years of fire data show 89 fires burned about 150,000 total acres with an average of 8,300 acres burned per year. For BLM-administered lands exclusively in that same period, 79 fires burned about 25,000 total acres with an average of 1,400 acres burned per year. Years with the most fires reported were 1996 (21 fires) and 2006 (12 fires). The most acreage burned in a single year was in 2006, with approximately 58,000 acres burned across the planning area and about 7,770 acres burned on BLM surface (BLM 2007d). Lightning causes the most wildlfires in the planning area. Human-caused fires are usually accidental from fireworks, open-air burning, wood cutting, railroad and vehicle malfunction, cigarette smoking, escaped campfire, and escaped prescribed fire.

Table 3.23. Annual Average Acres of Planned and Unplanned Fires in Different Vegetative Types in the Planning Area from 1990 through 2007

Vegetation Type	Unplanned Fire	Planned Fire
Agriculture	72	0
Aspen	109	0
Ponderosa pine	9,726	470
Lodgepole pine	3,891	63
Douglas-fir & limber pine	1,787	438
Spruce/Fir	518	0
Mixed grass prairie	93,033	4,308
Mountain shrub	1,622	47
Riparian forest-dominated	173	0
Riparian herbaceous-dominated	5	0
Riparian shrub-dominated	298	0
Sagebrush	36,296	1406
Other (sparse vegetation or no record)	2,445	138
Total	**149,974**	**6,869**
Source: BLM 2012f		

In areas with scattered parcels of BLM surface estate, suppression response to small (1 to 100 acre) wildfires is often managed unilaterally by the county fire resources. These fires are oftentimes not reported to BLM or the Casper Interagency Dispatch Center and are likely not included in BLM's fire database. BLM estimates that within the planning area an annual average of 15 wildland fires burning 120 acres are not included in the database.

The counties in the planning area have each developed Community Wildfire Protection Plans (CWPP) which identify fire prevention and protection needs and establish priorities for fire mitigation projects in wildland urban interface (WUI) areas. The county Fire Mitigation Coordinators and Wyoming State Forestry Division guide collaboration among agencies to produce and implement the plans. In the CWPPs, areas of concern such as WUI, are identified and prioritized based on fuel hazards, risk from wildfire, FRCC assessments, infrastructure, and other values such as view-sheds and watersheds. The Healthy Forest Restoration Act (HFRA) facilitates federal involvement by requiring interagency collaboration, especially when counties have completed CWPPs.

Fire management activities must comply with the smoke management requirements of the WDEQ Air Quality Division (AQD). For planned ignitions, BLM projects are usually large enough that they must be registered with the (AQD). and air quality must be visually monitored and reported. For unplanned ignitions in which the BLM has jurisdictional authority, there are communication, monitoring, and reporting requirements when the fire exceeds 50 acres.

Emergency stabilization and rehabilitation ES&R projects are implemented where undesirable effects from wildfire have caused resource damage or threaten public safety. Rehabilitation of firelines is not funded through the ES&R program, and must be included as part of the emergency management of the wildfire.

3.3.1. Unplanned Fire (Wildfire)

Where geographically allowed within an RMP planning area, current federal fire strategies allow a naturally caused unplanned ignition to be managed for both protection and resource benefit (multiple objectives). Currently there are no geographic areas designated in the planning area to manage unplanned ignitions for multiple objectives, so the single objective is suppression. However current and past suppression strategies include where appropriate, conditional or limited actions (indirect tactics such as burning out or holding at natural barriers) which may indirectly benefit resources by allowing more acres to burn while minimizing suppression damages. These actions are generally safer and typically reduce costs as compared to more aggressive actions such as direct fireline construction.

Best management practices (BMP) or standard operating procedures (SOP) are applied to wildfire response strategies in sensitive areas or habitats. For example, BLM has developed nationwide BMP for Greater Sage-Grouse habitat conservation for wildfire and fuels management (BLM 2011f). The WHPD has developed district-level fire suppression (BMP) to reflect objectives in the field office's RMPs. These district BMP address heavy equipment and fire retardant use, Greater Sage-Grouse habitat and leks, big game winter ranges, bald eagle winter roosts, cultural and historic properties, historic trails, highly erosive soils, range allotments, and noxious weed areas.

The Buffalo Field Office emphasizes minimal use of heavy equipment for fireline construction, except where protection from wildfire is critical for safety or to preserve sensitive resources. In special management areas with BLM surface restrictions, the BLM attempts to coordinate actions with interagency cooperators. Currently, special management areas include the Welch Management Area, the Weston Hills Recreation Area, the Burnt Hollow Recreation Area, the Fortification Creek WSA, the Gardner Mountain WSA, the North Fork Powder River WSA, the Dry Fork Petrified Tree Education Area, Cantonment Reno, and the Middle Fork Management Area.

There are several coal seam fires in and near the planning area which pose unique management issues and concerns. Coal seam fires may ignite wildfires and wildfires may ignite coal seam fires. Where ignitions can be prevented by removing vegetation, fire and fuels management strategies can be effective. Where these fires are discovered, fire personnel document and report the fires. Otherwise, coal seam fires are beyond the capabilities of wildland fire management and are discussed further in the *Health and Safety* sections of the RMP.

3.3.1.1. Regional Context

The Buffalo Field Office coordinates its fire suppression resources and operational support for pre-suppression planning and suppression actions at the WHPD level with the USFS, the Wyoming State Forestry Division (WSFD), county fire departments, and local fire protection districts. The BLM maintains Interagency Annual Operating Plans (AOP), which include operating agreements with county fire organizations and the (WSFD), Medicine Bow National Forest, Bighorn National Forest, Crow Tribal Agency, and neighboring BLM offices. The WHPD fire program coordinates activities through the Rocky Mountain Area Coordination Center (RMACC), which includes most of Wyoming and South Dakota, and all of Colorado, Nebraska, and Kansas.

3.3.1.2. Indicators

Fire as a disturbance mechanism on the landscape affects vegetation communities in terms of structure and species composition. For most vegetation settings, natural or historic fire frequency and severity maintain a characteristic range of seral stages on the landscape. If these fire effects are altered, some seral stages may become too abundant, underrepresented, or disappear. This in turn may effect future fire size or severity. Other factors such as invasive plants, or other types of disturbances may contribute to uncharacteristic conditions.

FRCC methodology is a standardized interagency process to assess and monitor fire disturbance regimes and associated vegetation conditions. FRCC uses five fire regime groups (Fire Regime Condition Class 2008) as shown in Table 3.24, "Fire Regime Condition Class System" (p. 285), and three condition class categories (see bullets below the table) that indicate the departure of a plant community/setting from its historic fire regime. If a plant community/setting has missed fire cycles, there may be changes to key ecosystem components such as species composition, richness, and structure; fuel load characteristics; fire size, severity, and burn pattern; and other associated disturbances such as insect or disease-related mortality.

Table 3.24. Fire Regime Condition Class System

Group	Frequency	Severity	Severity Description
I	0 to 35 years	Low/mixed	Generally low-severity fires replacing less than 75% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the over story.
II	0 to 35 years	Replacement	High-severity fires replacing greater than 75% of the dominant overstory vegetation.
III	35 to 200 years	Mixed/low	Mixed-severity with less than 75% of the overstory vegetation replaced.
IV	35 to 200 years	Replacement	High stand replacement-severity fires with greater than 75% of the dominant overstory vegetation replaced.
V	200 or more years	Replacement/any severity	Any (stand replacement) severity.
Source: Havlina 2010			

Condition class describes ecosystem health as follows:

- **Condition Class 1 (CC1):** Fire regimes on these lands are mostly within historical ranges. Vegetation composition and structure are intact. Therefore, the risk of losing key ecosystem components from the occurrence of fire is relatively low.
- **Condition Class 2 (CC2):** Fire regimes on these lands have been moderately altered from their historical range by increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified on these lands.
- **Condition Class 3 (CC3):** Fire regimes on these lands have been substantially altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure, and diversity have been substantially altered. Consequently, these lands verge on the greatest risk of ecological loss.

Regardless of disturbance mechanism, some lands fall into the CC3 category if they exhibit uncharacteristic vegetation such as non-native invasive plant species. For example, areas of high density annual bromes would be classified as CC3.

3.3.1.3. Current Condition

One of the goals of the fire program is to improve CC3 and CC2 conditions by implementing fire and fuels treatments, including appropriate management of unplanned ignitions. A district-wide FRCC assessment has been done for the planning area utilizing LANDFIRE National layers. Though there may be inaccuracies in the data inputs for this planning area, the coarse-scale results are helpful to broadly identify current conditions and the priority settings in which management actions could focus efforts. For BLM-administered lands in the Buffalo Field Office, Table 3.25, "Fire Regime Condition Class Assessment for the Buffalo Field Office" (p. 286) outlines the most common LANDFIRE BioPhysical Settings, the fire regime group of each setting, and the acres of each condition class. As improved or local data become available, the assessment will be updated and monitored via the WHPD FMP.

In the assessment it is important to view the general results rather than specifics such as names and exact acres. In general the fire regime groups and condition classes agree with local knowledge and experience, particularly in conifer settings where management actions may focus attention on CC3 acres. In sagebrush settings, management actions would prioritize preservation of sagebrush over FRCC objectives. Elsewhere, the assessment is helpful to prioritize, in conjunction with other land health assessments, areas where unplanned fire might be managed to improve FRCC in forest settings, wildlife habitats, WUI areas, and other resource objectives. See the *Planned Fire* section for further discussion about FRCC in relation to vegetation treatments.

Table 3.25. Fire Regime Condition Class Assessment for the Buffalo Field Office

LANDFIRE BioPhysical Setting Name	Fire Regime Group	Stand FRCC Acres for BLM-Administered Lands			
		Condition Class 1	Condition Class 2	Condition Class 3	Total Acres
Northwestern Great Plains Mixedgrass Prairie	2	217,566	155,575	15,021	388,161
Inter-Mountain Basins Big Sagebrush Steppe	4	99,578	83,577	3,258	186,413
Inter-Mountain Basins Montane Sagebrush Steppe	4	61,764	777	8,277	70,817
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	1	9,679	0	23,160	32,838
Southern Rocky Mountain Ponderosa Pine Woodland	1	2,416	16,501	3,978	22,894
Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna - Savanna	1	9,571	15,647	8,759	18,977
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	3	3,790	2	7,083	10,875

Source: LANDFIRE 2011

Assessment at HUCs 4, 5, & 6 for Wyoming High Plains District and joined to BLM-administered lands within the Buffalo Field Office.

BLM Bureau of Land Management
FRCC Fire Regime Condition Class
HUC Hydrologic Unit Code

3.3.1.4. Trends

Wildland fire management has been shaped by several forces in the past 100 years. Nationally, catastrophic fires (loss of life and property) at the beginning of the 20th Century resulted in 100% suppression policies for much of the next 70 years. This approach came into question as fuel loads increased in forests across the country. As a result land managers instituted a let-burn policy in the 1980s. In the late 1980s, several of these fires became larger than intended. These fires, followed by another intense season in 1994, caused another shift in management toward prescribed burning as a way to reduce fuel loads and prevent such intense fires. The focus on prescribed fire remained strong until several prescribed-fire disasters in 2000. After the 2000 wildfire season, the National Fire Plan (National Fire Plan 2009) was developed, with emphasis on developing firefighting resources; rehabilitation of fire-damaged lands; hazardous fuels reduction treatments; community assistance for fire mitigation and education projects; and accountability.

Across most of the US, fire seasons are generally lasting longer with uncharacteristically large and severe fires. It is anticipated that climate change will further extend fire seasons. Invasive plants such as annual bromes have expanded to create extensive areas of fine fuels, through which fire moves quickly and thoroughly. WUI areas have become more complex and extensive than previously considered in the 1995 and 2001 Federal Fire Policy reviews. To ensure firefighter and public safety, fire management activities in developed areas have required close coordination among all agency fire managers, including federal, state, local, and tribal lands. The National Fire Plan's guiding documents, and the Healthy Forest Initiative and Restoration Act address and facilitate this coordination.

Within the planning area, new or expanding concerns have changed the focus of wildland fire management. Energy development and human activity in the Powder River Basin will expand industrial interface areas and likely increase human-caused fires. Urban residential development is expanding throughout the planning area, especially in the southern Big Horn Mountains and foothills. With the potential listing of the Greater Sage-Grouse as a Threatened species, response to wildfires in Greater Sage-Grouse habitat has changed from limited or conditional suppression (indirect, least-cost tactics) to full protection. All of these changes increase costs and add complexity to wildland fire management.

3.3.1.5. Key Features

Key features are sensitive resources or important areas in the planning area that outline objectives for fire management. Specific to unplanned fire, other important features are BLM developed sites, industrial interface areas, and urban interface areas identified in the CWPPs. These areas would receive priority for wildfire protection and for hazardous fuels reduction treatments.

Depending on the alternative selected, unplanned ignitions may eventually be managed for multiple objectives in predefined areas. Key resource features in these future areas would indicate circumstances and strategies to meet resource benefit objectives with unplanned fires. The Campbell County CWPP encourages BLM to consult and coordinate the development of resource benefit fires in areas with larger blocks of federal lands.

3.3.2. Planned Fire (Prescribed Fire)

Prescribed fire is a wildland fire intentionally ignited by management under an approved plan to meet specific objectives. Implementation of prescribed fire projects is subject to the same policies, practices, and constraints that guide all fire management actions. As a planned activity, prescribed fire projects are subject to NEPA analysis, BLM policies, and Wyoming state requirements. In the planning area, mechanical treatments and chemical treatments are used in conjunction with fire or instead of fire to meet resource objectives.

Developed sites on or adjacent to BLM-administered lands receive highest priority for fuels management activities. The counties in the planning area have each developed CWPP which identify and establish areas of concern such as WUI or industrial interface, and prioritize the areas for treatments or other actions. The BLM fuels and forestry programs have worked with other agencies and fire authorities to collaborate hazard fuels assessments, mitigation plans, and treatments in urban interface areas. The BLM has initiated and funded cooperative agreements in the southern Big Horn Mountains to support defensible space protection for structures adjoining public lands.

Fuels treatments in non-interface areas are based on interdisciplinary objectives such as forest and rangeland health, and wildlife habitat protection or improvement. In forest treatments, prescribed burning typically follows mechanical treatments to reduce activity fuels such as slash piles, but sometimes fire treatments may include broadcast burning to reduce surface fuels and encourage shrub, grass, and forb regeneration. To complete some forest treatment projects, several years may be required to implement all phases of mechanical and prescribed fire treatments.

Fuels management objectives in Greater Sage-Grouse habitat reflect current guidance for Greater Sage-Grouse habitat conservation, including maintenance and protection of existing habitat, and restoration of previous habitat. Best management practices for fuels treatments would be applied to project design, including required habitat assessments.

Limber pine was listed as a Wyoming BLM sensitive species in 2010 because of high mortality from white pine blister rust and bark beetle epidemics in the central and northern Rockies. In addition, there is incomplete understanding of the species' potential ecotone shift and future range as climate change progresses. In the past several decades, limber pine and juniper have expanded into mountain shrub communities and foothill sagebrush communities and have affected important wildlife habitat. Prescribed fire treatments and more recently mechanical treatments have targeted removal of conifers in these shrubland habitats. Other vegetation treatments in limber pine stands have included forest health projects in the southern Big Horns, which have attempted to alleviate insect and disease problems and hazardous fuel loadings. With limber pine listed as a BLM sensitive species, projects must consider the limber pine and maintain an appropriate limber pine component on the site. To assist with these assessments, the BLM has developed statewide management guidelines for whitebark pine and limber pine (five needle pines) which include general guidelines for fire management, and general silvicultural prescriptions for mechanical treatments in a wide range of limber pine settings.

3.3.2.1. Regional Context

The Buffalo Field Office coordinates implementation of prescribed fire projects at the district level and uses nearest available resources such as adjacent BLM districts, the USFS, the WSFD, county fire departments, and qualified contractors. Where non-BLM-administered lands are included in treatment areas, the BLM enters into MOUs with affected parties.

3.3.2.2. Indicators

See the *Unplanned Fire (Wildfire)* section for the discussion of the FRCC system used to classify ecosystem fire characteristics and prioritize areas for treatments.

3.3.2.3. Current Condition

See the *Unplanned Fire (Wildfire)* section for further discussion of the FRCC assessment in the planning area. In the assessment it is important to view the general results rather than specifics such as BioPhysical Setting names and exact acres. In general the fire regime groups and condition classes agree with local knowledge and experience, particularly in conifer settings where vegetation treatments may focus attention on CC3 acres. In Greater Sage-Grouse habitat, sagebrush preservation and protection would be prioritized over FRCC objectives and restoration of fire regimes. Alternatively, in forest and woodland settings, especially where there are interface developments, treatments would be prioritized to reach CC1 conditions. Elsewhere, the assessment is helpful to prioritize, in conjunction with other land health assessments, areas where vegetation treatments could improve fire regime condition classes in forest health treatments, wildlife habitat projects, and other resource improvement projects.

3.3.2.4. Trends

The Buffalo Field Office has maintained a prescribed fire program since the early 1980s. From 1985 through 2001, most prescribed fires were broadcast burns of sagebrush/grass fuels performed to meet livestock and big game wildlife forage objectives. Secondary objectives were to reduce or break the continuity of fuels, thereby reducing the risk of high severity or uncharacteristic effects from wildfire. Most of the prescribed burns were implemented in cooperation with individual grazing lessees and WGFD-managed habitat units. During the 17-year period, the BLM had the lead role in performing 12 prescribed fires covering an estimated 6,000 acres, of which approximately 30% was public land surface.

With passage of the National Fire Plan (National Fire Plan 2009) and subsequent Congressional actions and Executive Orders, the emphasis on prescribed fire shifted toward hazardous-fuel reduction, especially in the wildland urban interface. Hazardous-fuel reduction objectives have been accomplished in the planning area using both prescribed fire and mechanical treatments. From fiscal years 2003 through 2008, the Buffalo Field Office implemented 15 prescribed fire projects within WUI to treat approximately 3,100 acres of public land, and 17 prescribed fire projects outside WUI to treat approximately 5,200 acres of public land. During that same period, the Buffalo Field Office implemented 13 mechanical fuel treatments within WUI to reduce hazardous fuels on approximately 224 acres of public land. Outside WUI in that period, eight mechanical fuel treatments were applied to 582 acres of public land. Most of the non-WUI mechanical treatments were associated with forest management treatments, or salvage actions following wildfire. Two mechanical projects were implemented to improve rangeland conditions.

With the warranted but precluded listing of the Greater Sage-Grouse and the expansion of annual bromes in the planning area, prescribed fire treatments have declined in sagebrush settings. Fuels treatments have focused on reducing conifer expansion in Greater Sage-Grouse habitat, and will trend towards treatments that protect or restore sagebrush habitats from fire damage or invasive plant species.

An important part of future treatments in any site will utilize native plant materials developed through BLM's Seeds of Success program. This program facilitates local seed collections that may be grown out as seedlings or seed stock for use in rehabilitation or restoration projects.

3.3.2.5. Key Features

Key features are important areas or sensitive resources that outline objectives for fire and fuels management. Relative to planned fire and fuels treatments, key features could be vegetation situations which do not meet management objectives and may require treatments. Examples include fire, mechanical, or chemical treatments in shrubland habitats to remove conifer expansion, or forest health treatments to reduce the risk of insect and disease infestations.

Specific to hazardous fuels management, key features include the WUI areas of concern identified in the CWPPs. These areas are considered at risk from wildfire and have been prioritized in the WUI to receive fuels treatments and fire education efforts. Where BLM-administered lands intermix with these areas of concern, BLM prioritizes treatments to match the priorities of the (WUI. In Johnson County, BLM-administered lands in the Clear Creek watershed and lands accessed by the Hazelton Road are current priorities for BLM treatments. Current priorities in Sheridan County are the BLM-administered lands along Red Grade Road; and in Campbell County, the BLM is encouraged to continue hazardous fuels reduction and resource improvement projects in general.

3.3.3. Stabilization and Rehabilitation

Rehabilitation of firelines is part of the fire suppression emergency response and is paid for by suppression funds. Repairs from fire suppression damages should be done with suppression or contract resources as soon as possible after fire containment. Emergency Stabilization and Rehabilitation projects are done after fire containment to repair damages from the fire itself. ES&R projects must compete for funding at the national level.

Emergency stabilization actions are implemented soon after the fire to protect life and property; to stabilize soils and watersheds; to protect unique biological resources; and significant heritage sites. These stabilization actions include project planning and NEPA documentation, and must be implemented within 1 year of fire containment.

Burned-area rehabilitation projects are developed to restore fire-damaged lands which are unlikely to recover naturally. In rehabilitation plans there is no immediate threat to safety or a specific resource, and treatments may include repair or replacement of minor facilities such as fences and campgrounds. These plans must undergo NEPA analysis and must be completed within 3 years of fire containment.

3.3.3.1. Regional Context

Since 2005, the Wyoming High Plains District has reported four ES&R burned-area rehabilitation projects; three in the Newcastle Field Office and one in the Buffalo Field Office. In contrast hundreds of projects have been reported in other western states since 2005, where annual bromes have altered fire behavior and severity, or where damaged watersheds affect WUI areas.

3.3.3.2. Indicators

Large fires in conifer settings, critical watersheds, WUI areas, or areas at risk from invasive plants could be cause to initiate formal ES&R planning.

3.3.3.3. Current Condition

The current RMP and update provide for emergency stabilization and rehabilitation of any area affected by wildfire. ES&R projects are implemented to stabilize slopes which threaten public health or safety or to rehabilitate lands that are unlikely to recover from undesirable wildfire effects.

See *Unplanned Fire (Wildfire)* and *Planned Fire (Prescribed Fire)* for a discussion of the FRCC assessment. Condition Class 3 (CC3) situations in forested settings or from annual brome expansion could create large fire size or undesirable fire effects which require ES&R treatments.

3.3.3.4. Trends

From 1985 to 2003, the Buffalo Field Office developed one ES&R plan for the 2003 Big Spring Fire, which was in the southern Big Horn mountains adjacent to the Billy Creek area where there is a high density of summer cabins. The plan included emergency actions such as hazardous tree felling, and non-emergency rehabilitation actions such as road grading and facilities replacement.

Approximately 50% of the wildfires in the planning area have required varying degrees of rehabilitation of suppression damage, consisting primarily of re-contouring slopes, reseeding, and water barring fire lines.

With the warranted but precluded listing of the Greater Sage-Grouse and the expansion of annual bromes in the planning area, it is likely there will be increased need for rehabilitation of burned areas and restoration of sagebrush/grasslands after wildfire. In fact, since 2011 two additional ES&R plans have been developed to treat annual bromes and other weeds in Greater Sage-Grouse habitat, and other funding will follow up with sagebrush seeding treatments. Although other large fires in 2012 burned Greater Sage-Grouse Core Population Area and Connectivity Corridor habitat, ES&R plans were not developed primarily because funding was not available. Weed treatments and restoration of Greater Sage-Grouse habitat will be done as possible with other funding sources.

With the development of BLM's national Seeds of Success program, native and local native plant materials will become more widely available for ES&R work.

3.3.3.5. Key Features

Key features are sensitive resources or important areas in the planning area that outline objectives for fire management. Specific to unplanned fire and ES&R treatments, important areas would include WUI watersheds, high severity burns in forested settings, areas with important wildlife habitat, and areas where invasive plant species threaten the burned area.

3.4. Biological Resources

3.4.1. Vegetation – Forests and Woodlands

This section describes existing conditions for forest and woodland vegetation communities within the planning area. Table 3.26, "Distribution of Forests and Woodlands on BLM-Administered Land in the Buffalo Planning Area" (p. 292) lists the acreages of forests and woodlands in the planning area.

Table 3.26. Distribution of Forests and Woodlands on BLM-Administered Land in the Buffalo Planning Area

Classification	Planning Area (Acreage)	BLM Acreage
Forests	651,000	51,224
Woodlands	26,147	26,005
Total	**670,225**	**77,229**

Source: BLM 2012f

BLM Bureau of Land Management

Note: Acreages do not sum to total because of resource overlap.

3.4.1.1. Regional Context

The planning area lies on the east side of the Big Horn Mountain and extends into the Powder River Basin. The ecoregions for the forest lands are the Granite Subalpine Zone, the Dry Mid-Elevation Sedimentary Mountains, and the Pryor Bighorn Foothills. There are 7 major forest management units and smaller units that are scattered tracts from the north end of the planning area west of Sheridan, Wyoming on the Red Grade Road and larger contiguous tracts that extend from Mosier Gulch to the Hole in the Wall campground in the South Big Horns. The geographical area includes the Billy Creek forest management area at the North end of Hazelton Road on the east facing slopes of the Big Horns, the Powder River Management Area, Hazelton Road Management Area, the Horn, Bear Trap Management Area, Garden Mountain Management Area, and the Graves Corral Management Area on the southern end.

There are scattered woodlands throughout the tri-county area with concentrations of woodlands in Campbell and Johnson counties. They are concentrated in the Pine Scoria Hills, the Casper Arch, the Mesic Dissected Plains, and the Powder River Basin Ecoregions. The woodlands in Campbell County, extend from Dead Horse Creek to Bitter Creek on the Montana border, on the east side from Homestead Draw to Horse Creek, and in the southeast from Corral Creek to 7 Prong Creek. The woodlands extend on the east side of the south Big Horns to the Middle Fork Powder River in Johnson County.

3.4.1.2. Indicators

The forest and woodlands need to managed for ecosystem health. The resources that play a role in the forest and woodland health, such as soil and water should be conserved and maintained. Indicators of forest and woodland health are the amount, diversity, and age class structure of the forest and woodland communities. The goal is for healthy forest and woodland communities sustained in their desired ecological conditions. Forest and woodland communities should be resilient, diverse, and able to recover from natural and human disturbances. The BLM uses the Forest Vegetation Information System (FORVIS) for storage, retrieval, and analysis of both tabular and spatial data about forest lands. Outputs of this system include descriptions of existing vegetation, classifications of sites relative to current conditions, potential vegetation and site productivity, data to run forest growth and structure models, inputs for wildlife habitat models, landscape descriptions, quantification of forest products, aids for developing silviculture or forest restoration treatments, and records of treatments and disturbance events.

3.4.1.3. Current Condition

The Buffalo Field Office administers 77,229 acres of forests and woodlands. Forests and woodlands are distinguished by type (species composition) and the physical environment in which they grow.

Forest Communities

The dominant forest species include lodgepole pine, ponderosa pine, Douglas fir, Engelmann spruce, subalpine fir, and aspen. Forest composition ranges from pure single species stands, to stands of mixed species. Ponderosa pine dominates at the lower elevations and on the northern aspects, Douglas fir and lodgepole pine are often present also. As the elevations rise, ponderosa pine forests become scattered and less frequent while lodgepole pine and Douglas fir forests increase and become dominant.

Aspen stands are influenced by soil moisture and fertility. Therefore aspen stands are often small and scattered throughout the lodgepole pine and Douglas fir zone. Aspen is an early successional species, intolerant of shade, and therefore is replaced by the shade tolerant conifers.

Forests support, define, and create stability for a multitude of resources, including watersheds (soil and water), wildlife (provide protection, food, and habitat), recreation, air quality (carbon sequestration), other plant communities, products for mankind (e.g., homes and paper products), and are aesthetically pleasing. Forest communities and forest management areas in the planning area are displayed on Map 20. Forest products are discussed further in their own section.

Past harvesting activities, fire suppression, and natural succession have promoted the development of dense forest stands throughout these mountains. Lodgepole pine, ponderosa pine, and Douglas fir stands are unnaturally dense and dominated by a single canopy layer from mid-age to over-mature trees. Consequently, competition among trees for water, light, and nutrients is pronounced.

The distribution of aspen and limber pine is declining. Aspen is a successional species that benefits from fire. Reduced burning and competition from conifers has decreased the number, the health, and the vigor of aspen clones. According to a report on forest health published by the WSFD, the average age of aspen forests is 68 years (Wyoming State Forestry Division 2001). The limber pine is being infected by blister rust disease that is resulting in mortality. The Forest Service (USFS 2008) estimates blister rust has caused a 60% mortality rate. Limber pine, though not a desirable commercial species, is favored by the Clark's nutcracker and many small rodents for its seeds.

Woodland Communities

Woodland communities are scattered throughout the three-county planning area (Map 20). They range from small monotypic stands to large mixed stands of quaking aspen, limber pine, ponderosa pine, Rocky Mountain juniper, and Utah juniper. The largest woodland stands occur in the southern Big Horn Mountains. Woodlands differ from forests because woodlands typically grow as savannah. The trees are widely dispersed with grasses, forbs, and shrubs in the understory. Because of the open growing conditions, woodlands exhibit different growth characteristics from forests. The tree crowns extend from the base of the bole to the top of the crown. Woodlands play an important role in the landscape as they provide cover, food, and protection for many wildlife species.

Woodland communities typically do not produce wood that is desirable for high-quality wood products. However, woodlands play an important role in the woody biomass market. They are utilized as firewood, furniture, decorative, and hobby wood products.

Fire suppression has enabled the expansion of woodlands into meadows. This is desirable in some locations, but undesirable in others. Concerns with encroachment include woody fuel buildup, especially in the wildland-urban interface, and the loss of open meadows. Woodland encroachment into meadows typically reduces biological diversity and available forage.

3.4.1.4. Trends

Stressed trees have poor resistance and are therefore vulnerable to attacks by the mountain pine beetle, ips engraver beetle, Douglas fir beetle, rust, and diseases. The USFS Forest Health Protection report indicates a growing Douglas fir beetle problem and an increase in acres affected by insects and disease in the Big Horns.

Increased pressure on forest and woodland communities will continue with increasing energy development. Woodland communities would be affected most with their greater distribution within the planning area; the predominant threat to forest communities would be the introduction of renewable energy development to the southern Big Horn Mountains and restrictions placed on forest and woodland management by other resource values.

3.4.1.5. Key Features

Aspen and limber pine communities are key features due to their declining trend within the planning area and across their geographic ranges. Table 3.27, “Acres of Dominant Tree Species in the Planning Area” (p. 294) portrays the acreage of dominant tree species in the planning area.

Table 3.27. Acres of Dominant Tree Species in the Planning Area

Dominant Tree Species	Acres on BLM-Administered Land
Ponderosa pine	28,521
Lodgepole pine	10,289
Douglas fir/Limber pine	12,208
Spruce/Fir	48
Aspen	0
Juniper	0
Riparian Mix	8
Source: BLM 2012f BLM Bureau of Land Management	

3.4.2. Vegetation – Grassland and Shrubland Communities

Grasslands and shrublands are the most productive grazing land in the planning area. These two community types can be found from the foothills of the Big Horn Mountains to the east boundary of the planning area (Map 19). These communities symbolize the "open" prairie landscapes that typify Wyoming. Grasslands represent most of the topographical positions, from the open plains to the foothills, to dry mountain slopes. Grasslands in the plains are dominated by cool-season grasses, sedges, and shrubs, mainly sagebrush. The warmest and driest grasslands can also have warm-season species with few shrubs. Sagebrush is the most dominant shrubland type within the planning area, found primarily on the open plains, but also in mountain settings. It is dominated by Wyoming big sagebrush, mountain big sagebrush, mountain mahogany, and greasewood. Wyoming big sagebrush tends to grow in the low to mid elevations on the drier sites, while mountain big sagebrush occurs in upper elevations in moister conditions, in the southern Big Horn Mountains. Vegetation supports clean water, soil health, fish and wildlife habitat, livestock forage, recreation, natural carbon sequestration, and scenery.

Vegetation characteristics that are common indicators of vegetation health include cover, composition, amount of bare-ground and litter, structural diversity, species diversity, and the presence and density of invasive species. These indicators are associated with ecological sites and with Standards 1, 3, and 4 of the *Standards for Healthy Rangelands and Guidelines for Livestock Grazing Management for Public Lands Administered by the BLM in the State of Wyoming* (BLM 1998). Ecological sites are determined from USDA Natural Resources Conservation Service for MLRA [Major Land Resource Area (geographically associated land resource units)]: 58B – Northern Rolling High Plains.

Grassland and shrubland communities account for approximately 6,293,727 acres of the planning area, of which 718,636 acres are BLM surface. Most of the grassland and shrubland communities in the planning area have been influenced by livestock grazing, fire or fire suppression activities, and surface-disturbing activities.

3.4.2.1. Regional Context

The Buffalo Field Office lies within one MLRA: the Northern Rolling High Plains, Southern Part – 58B (NRCS 2008). This area is characterized by grasses and shrubs with gently rolling to steep slopes and occasional flat-topped, steep sided buttes rising above the plains. Elevations range from 3,800 to 11,000 feet, with elevation increasing gradually from north to south.

3.4.2.2. Indicators

The condition of the grassland and shrublands in the planning area was evaluated utilizing the ecological site inventory. Any land inventory, analysis, and resulting management decisions require knowledge of these individual sites and their interrelationships to one another on the landscape. The ecological site description contains information about the individual ecological sites.

The data comprising an ecological site description is presented in four major categories:

- Site Characteristics – Identifies the site and describes the physiographic, climate, soil types and limitations, and water features associated with the site.

- Plant Communities – Describes the ecological dynamics and the common plant communities comprising the various vegetative states of the site. The disturbances that cause a shift from one state to another are also described.
- Site Interpretations – Interprets information pertinent to the use and management of the site and its related resources.
- Supporting Information – Provides information on sources of information and data utilized in developing the site description and the relationship of the site to other ecological sites.

Congress mandated natural resource inventories in Section 201(a) of the FLPMA. Congress reaffirmed this mandate in Section 4 of the Public Rangelands Improvement Act of 1978 – in particular, to develop and maintain an inventory of range condition and trends on public rangelands, and to keep that inventory updated. The BLM does and will continue to use land health status to report condition and trends of rangelands in compliance with FLPMA and the Public Rangelands Improvement Act of 1978. Ecological Site Descriptions will be used as the foundation for determining rangeland health status by identifying the soil types and potential vegetation communities. The process spelled out in BLM Handbook H-4180–1, Rangeland Health Standards, will be used to assess and evaluate rangeland health status.

3.4.2.3. Current Condition

Livestock grazing is the largest and most historic use of grasslands and shrublands in the planning area (see the *Livestock Grazing Management* section of this chapter for more information).

The second largest impact on grasslands and shrublands, in the planning area, is mineral development. This impact occurs throughout the ecosystems in northeastern Wyoming and involves the extraction of gas, oil, coal, uranium, bentonite, and other minerals. Extraction of these minerals has resulted in direct removal of sagebrush and grasslands. Mine excavation, roads, drill pads, fences, powerlines, pipelines, and other mining activities fragmented habitat. Surface-disturbing and other activities caused removal or mechanical damage to plants, invertebrates, and biological soil crusts. Damage occurred in terms of both the amount (overall biomass, density, and cover) and diversity (species presence and richness). These activities can be associated with the recent increases in the introduction and spread of invasive species, and compaction of soils.

The continuation of CBNG and energy development drives conditions on grasslands and shrublands. Conditions include the number of acres of soil and vegetation disturbance from construction of roads, trails, well sites, and utility corridors. Disturbance also includes the number of water-holding impoundments, which often are in the most productive vegetative areas (draw bottoms) and their associated seeping, which provides a premium medium for the establishment of invasive species. Reclamation practices on these disturbed sites included the introduction of non-native species to stabilize soils, which out-competed native species, disrupted grazing systems during site development and reclamation, and provided opportunities for invasive species, including the annual brome species, to occupy exposed soils. Other drivers include disposal of CBNG produced water, which altered soil capabilities and functions and the vegetative community, moving the vegetative community from a natural xeric plant community to a mesic community.

The impacts to grassland and shrubland communities from drought has varied widely. The primary impacts of extended drought were reduced vegetative production, cover canopy, diversity, microbial function, and heights of grasses, and increased soil erosion. Drought also provided a growing advantage to annual bromes because even low amounts of snowfall were adequate to provide enough moisture to initiate growth in late winter through seedset in spring. Additional factors that brought change to the planning area included the occurrence or lack of wildfires, global warming, development of recreational sites and opportunities, and sprawl of human dwellings in rural settings.

Management challenges for grassland and shrubland communities include the spread of invasive species; lack of a natural fire regime; integrating treatments of multiple resource programs to achieve landscape-level objectives; future energy development; the potential impacts of global warming; competition for forage between native ungulates and livestock; habitat fragmentation; restoration of areas damaged by surface-disturbing activities to mitigate potential impacts related to erosion and water quality; competition between resource users; and maintaining a distribution and diversity of these communities sufficient to support wildlife, special status species, livestock, and other competing multiple-use demands on BLM-administered lands.

Table 3.28, "Distribution of Grasslands/Shrublands on BLM-Administered Land in the Buffalo Planning Area" (p. 297) lists the acreages of grasslands and shrublands in the planning area.

Table 3.28. Distribution of Grasslands/Shrublands on BLM-Administered Land in the Buffalo Planning Area

Vegetation Class	BLM Surface Acres	% of BLM-Administered Land within the Planning Area
Mixed Grass Prairie	83,349	11
Short Grass Prairie	453,153	58
Other Shrubland (Mesic Upland Shrub Steppe and Xeric Upland Shrub Steppe – Mountain Mahogany)	14,250	2
Sagebrush shrubland (Wyoming Big Sagebrush and Grassland and Mountain Big Sagebrush and Grassland)	167,884	21
Source: BLM 2012f BLM Bureau of Land Management		

See the *Livestock Grazing Management*, *Fire and Fuels Management*, and *Invasive Species and Pest Management* sections of this document for additional information.

The following sections describe the grassland and shrubland vegetation communities in the planning area.

Grasslands

Short-grass Prairie

This vegetative type represents very sparse, sparse, and thin dry herbaceous rangeland types, as defined by the WGFD. The 453,153 acres of short-grass prairie comprises approximately 58% of the BLM surface in the planning area. This vegetative type occurs on drought-prone, mildly alkaline, medium-textured, and fine-textured soils. Few shrubs grow consistently in short-grass prairie because the soils are too dry and compacted to support them. In the planning area, short grass prairie habitats are most common in the south, occurring as the dominant plant community from the southern foothills of the Big Horn Mountains to the eastern boundary of the planning area. The topography consists of gentle rolling plains occasionally dissected by draws, creeks, and rivers. Pine-covered ridges with numerous draws are common. According to NRCS Major Land Resource Area 58 B Northern Rolling High Plains, this area is mapped in the 10-inch to 14-inch precipitation zone. Precipitation is an important determinant of the composition of plant species in grasslands. The dominant vegetation species are blue grama, western wheatgrass, sand dropseed, needle and thread, scarlet globemallow, and four-wing saltbush.

Mixed-grass Prairie

This vegetative type is a combination of low, medium, and high herbaceous rangeland types, as defined by the WGFD. The 83,349 acres of mixed-grass prairie comprises about 11% of the BLM surface in the planning area. The topography consists of gentle rolling plains occasionally dissected by draws, creeks, and rivers. Precipitation is an important determinant of the composition of plant species in grasslands. Mixed-grass prairie can be divided into several types and is characterized by several common species, including needle and thread, western wheatgrass, blue grama, pricklypear cactus, and scarlet globemallow. Wyoming big sagebrush is a common shrub of this grass community in the Powder River Basin (Knight 1994). In the planning area, mixed-grass prairie habitats are most common along the eastern foothills of the Big Horn Mountains and occur throughout much of the northern and central portions of the planning area. According to NRCS Major Land Resource Area 58 B Northern Rolling High Plains (NRCS 2008), the foothills area is mapped in the 15-inch to 19-inch precipitation zone and the northern and central areas are mapped in the 10-inch to 14-inch precipitation zone, but generally receives 8 inches to 12 inches of precipitation annually, the majority of the precipitation comes in late winter and early spring.

Shrublands

Sagebrush Shrubland

This vegetative type includes a combination of sparse, moderately dense, and dense big sagebrush crown closure with a variety of understory grasses and forbs. The sagebrush shrubland is widely distributed and occupies a large portion of the planning area — approximately 167,884 acres (21%). Generally, Wyoming big sagebrush communities are found below 6,000 feet and mountain big sagebrush communities above 7,000 feet. However, between 6,000 and 7,000 feet the two plants often are found growing together and are difficult to discern. Black sagebrush is generally found at mid elevations, between 5,000 and 7,000 feet, on shallow to very shallow rocky soils, in areas with 10 to 14 inches of precipitation. Black sagebrush grows in association with both Wyoming and mountain big sagebrush. Basin big sagebrush is generally restricted to moderately deep to deep soils in drainage bottoms and stream terraces. Basin big sagebrush communities do not cover much area and are mostly components of other shrub communities. Silver sagebrush is usually found at lower elevations on sandy soils. It is more abundant in the southern part of the planning area and is the principal shrub on sand dunes.

Sagebrush communities are important sources of food and cover for numerous wildlife species in Wyoming. Sagebrush-obligate species include the sage sparrow, Brewer's sparrow, sage thrasher, Greater Sage-Grouse, sagebrush vole, sagebrush lizard, and pronghorn. See the *Fish and Wildlife Resources – Wildlife* and *Special Status Species – Wildlife* sections of this chapter for more information.

Wyoming Big Sagebrush and Grassland

Wyoming big sagebrush is usually found on drier sites, occurring throughout the lower elevations across the majority of the planning area. Shrub height varies from as little as 8 inches on shallow soils to approximately 30 inches on deeper soils. The canopy cover for Wyoming big sagebrush communities usually does not exceed 20%.

Wyoming big sagebrush often appears as the dominant plant in mosaic communities intermixed with other shrubs and open grasslands. On shallow or rocky to gravelly soils, Wyoming big sagebrush may be co-dominant with black sagebrush and yellow rabbitbrush. On lighter-textured soils, such as sandy loams, Wyoming big sagebrush may be co-dominant with silver sagebrush, yellow rabbitbrush, and winterfat. Grass and forb species vary depending on soil texture, aspect, and slope. Common grass and grass-like species include bluebunch wheatgrass, western wheatgrass, Sandberg bluegrass, muttongrass, Indian ricegrass, needle and thread, green needlegrass, prairie junegrass, threadleaf sedge, and squirreltail. Common forbs include phlox, sandwort, buckwheat, penstemon, Indian paintbrush, scarlett globemallow, milkvetch, and pricklypear cactus.

Many of the Wyoming big sagebrush communities consist of even-aged stands of mature and often decadent plants. This presents a problem on winter ranges because of the poorer forage quality of the plants and lack of recruitment of younger plants.

Mountain Big Sagebrush and Grassland

Mountain big sagebrush is found on shallow to deep soils at elevations above 7,000 feet. It occurs along the western edge of the planning area, throughout the Big Horn Mountains. In areas where it grows in conjunction with Wyoming big sagebrush, it generally grows on the deeper soils and in areas that receive more moisture either through runoff or snow accumulation. At lower elevations, annual precipitation levels average 15 inches to 19 inches, and at higher elevations annual precipitation averages more than 20 inches.

At higher elevations, mountain big sagebrush occurs as smaller plant communities in mountain areas and is often intermixed with aspen and conifer woodlands. Shrub height will vary from 10 to 30 inches, with canopy cover reaching 20 to 40%.

Other shrubs that can be found in mountain big sagebrush communities are antelope bitterbrush, Saskatoon serviceberry, threetip sagebrush, and snowberry. Grasses present include Idaho fescue, spike fescue, green needlegrass, Colombia needle grass, muttongrass, western wheatgrass, and basin wildrye. Common forbs found in these areas include Indian paintbrush, lupine, larkspur, ragwort, and violets.

Mountain big sagebrush is palatable to wildlife, although browsing is limited during winter when these habitats become unavailable due to snow. Mountain big sagebrush provides hiding and nesting cover for various wildlife species. Following fire, mountain big sagebrush reestablishes as the dominant species more quickly than do other sagebrush types, often resuming dense canopy cover after only 20 to 30 years.

Other Shrubland

This vegetative type is composed of shrub-dominated vegetation communities – mountain mahogany and greasewood shrubland. Mountain mahogany shrubland is the largest component of the other shrubland vegetation type and occurs primarily in the foothills of the Big Horn Mountains in southwestern Johnson County. Mountain mahogany grows on xeric (drier) sites, usually in isolated, pure patches that are often very dense on rocky areas with shallow, poorly developed soils derived from sandstone, limestone, and shale. Their ability to use nitrogen from the soil enables these shrubs to establish on relatively infertile soils. They grow most vigorous on sites without forest canopy and provide important browse for wildlife and livestock. The sustained protein levels of the plants through the winter provide considerable value as forage (Knight 1994). Plant species in the undergrowth of this community include fringed sage, sulfurflower buckwheat, bluebunch wheatgrass, and junegrass.

Greasewood-dominated shrublands occur primarily on lowland positions adjacent to streams, playas, and ponds. They usually occur in areas that receive lower amounts of precipitation and on soils that are at least moderately saline or alkaline. Greasewood does well in very saline soils; however, it needs more soil moisture than most of the local shrub species. Where greasewood is the dominant shrub, subdominant shrubs include Gardner saltbush, shadscale, rubber rabbitbrush, Wyoming big sagebrush, and basin big sagebrush. The understory is limited to salt-tolerant herbaceous vegetation, such as inland saltgrass, western wheatgrass, alkali sacaton, squirreltail, Sandberg bluegrass, spiny phlox, and pepperweed. Although greasewood is not considered to be very palatable to livestock or big game animals, pronghorn and sheep will eat the spiny twigs and leaves in spring and early summer, and cattle use this species in summer and fall as a source of salt. Greasewood contains soluble oxalates that can be poisonous to both sheep and cattle. Greasewood does provide food and cover for small animals and birds.

Mesic Upland Shrub Steppe

Chokecherry is the primary shrub in this community. It often grows in conjunction with snowberry, currant, Woods' rose, and serviceberry. This community type is usually present at lower to mid elevations in areas that receive greater moisture due to snow accumulation, runoff, or subsurface flow. These areas include drainage bottoms, north slopes, and leeward sides of hills and are primarily located in the northern portions of the planning area. This community usually exists as dense but scattered stands of shrubs and is often adjacent to aspen and willow communities. Chokecherry and Saskatoon serviceberry can grow to 15 feet high. Herbaceous understory vegetation includes basin wildrye, green needlegrass, Columbia needlegrass, bluebells, columbine, common yarrow, and violet. Precipitation ranges from 15 inches to 19 inches annually.

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. The new growth is highly palatable and is sought by browsing animals.

Xeric Upland Shrub Steppe – Mountain Mahogany

Mountain mahogany is present in the southern portions of the planning area along the southern slopes of the Big Horn Mountains. The species grows on dry sites, usually rocky slopes and ridges with very shallow soils. Mountain mahogany usually occurs as the dominant shrub but sometimes grows in conjunction with juniper, antelope bitterbrush, currant, snowberry, yellow rabbitbrush, and Wyoming and mountain big sagebrush. Grass species present in the understory include bluebunch wheatgrass, Indian ricegrass, Sandberg bluegrass, muttongrass, and western wheatgrass. Forb species present in the understory include phlox, locoweed, and milkvetch.

Mountain mahogany can grow to a height of 5 to 7 feet, depending on the amount of browsing and the soil depth. Fire generally decreases the density of the shrub stands, allowing grasses and other herbaceous plants to increase, while still providing wildlife browse. If cheatgrass is present, fire can lead to an increase of this species. Mountain mahogany is an important fall and winter forage for deer and elk, and also is utilized by livestock. Mountain mahogany communities usually provide crucial winter range for mule deer. Many of these communities consist of mature and often decadent plants with little recruitment of young plants.

3.4.2.4. Trends

It is estimated that the trend for grasslands and shrublands will remain about the same. Range trend data from the RMP (1985) in the South Big Horns area and the Powder River Breaks area combined, was 18% of rangeland acres in an upward (improving) trend, 73% of acres in a static (stable) trend, and 14% of acres in a downward (degenerating) trend. The most recent cumulative trend date (BLM 2007l) shows 20% of rangeland acres in an upward trend, 45% in a static trend, one percent in a downward trend, and 34% undetermined. Some areas, especially those subject to CBNG development, will likely experience a slight downward trend in vegetative health due to the number of associated impacts, as described in the preceding sections. In other areas, the health trend will be upward due to monitored grazing practices, conservation use, deferred rotation for a portion of the ranch, and set asides for wildlife habitat.

Impacts to grasslands and shrublands from drought will vary widely. Other impact trends to these vegetative communities include division of ranches into smaller, more affordable, smaller acreage ranchettes. Impacts from this include increased fencing of property, increased roads and trails, intensified grazing management, and increased wildfire costs. Other secondary impacts include habitat fragmentation and an increase in the presence of invasive species.

3.4.2.5. Key Features

Key features include shrublands currently in Greater Sage-Grouse Priority Habitat Area (Core Population Area and Connectivity Corridor); potential habitat for sensitive, Threatened, or Endangered species, including black-tailed prairie dog colonies; and critical wildlife habitats that contain mountain mahogany.

3.4.3. Vegetation – Riparian/Wetland Resources

Riparian and wetland areas occur throughout the planning area. They are influenced by adjacent creeks, streams, rivers, lakes, and ponds. Riparian areas are often called riparian corridors or riparian zones because of the dependency of the ecosystem on water. Riparian communities vary considerably from small, sedge-dominated wetlands to large, willow-dominated stream corridors, to spruce bogs and alpine wet meadows. Riparian aspen communities are scattered on streams and springs.

Riparian and wetland communities are defined as having persistent water or obligate vegetation (e.g., sedges, rushes, and willows) reflecting the availability of surface water or groundwater. Healthy riparian areas provide vertical structural complexity, canopy, and subcanopy layers and a ground layer that supports species diversity. In addition to being an integral part of watershed health, riparian areas are prized for their cultural, historical, and recreational values, fish and wildlife habitat, water supply, and their economic values stemming from their use in livestock production, forest production, and mineral extraction.

The USFWS (Cowardin et al. 1979) developed and uses the scientific definition of a wetland as follows: Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is nonsolid is saturated with water or covered by shallow water at some time during the growing season of each year.

Functions

Riparian and wetland communities provide important functions, such as improving water quality, sustaining base flows, decreasing the impacts of floods, and providing wildlife habitats and forage, shade, and water for livestock. Vegetation in riparian and wetland areas influences stream communities by shading the stream (lowering water temperature), controlling dissolved nutrient inputs, stabilizing stream banks, and contributing organic matter. Streamside vegetation provides cover for fish by creating quiet, shaded resting areas beneath overhanging vegetation. The roots of riparian vegetation are crucial to the development and maintenance of undercut banks that also provide cover for certain fish species and help to stabilize the stream banks. Root stabilization of stream banks also allows soils to absorb extra water during spring runoff that is later released during drier months, thereby improving late summer streamflows.

3.4.3.1. Regional Context

Wetlands and riparian areas between the Rocky Mountains and the Sierra Nevada are incredibly diverse and valuable habitats. Wetlands are regionally sparse and very few are located within Wyoming. More than 80% of the wildlife species in this intermountain region depend on these wetlands–which account for less than two percent of the land area–for their survival. At the same time, the wetlands also serve the water needs of ranchers and farmers, recreationists, vacation communities, and cities. It is no exaggeration to call water the "liquid gold" of the West, and the burgeoning human demands on this scarce resource make it imperative to understand and properly manage the wetlands and riverine areas of the Intermountain West (McKinstry et al. 2004).

3.4.3.2. Indicators

All riparian habitats depend on a balanced combination of physical (stream bank, channel, and soil characteristics), hydrologic (regular occurrence of surface water), and vegetative (hydrophytic communities) components. When any of these three components – soils, water, or vegetation – are adversely affected, the functional capacity of a riparian habitat can be degraded. Riparian-wetland areas are properly functioning when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high-water flows and flooding, thereby reducing erosion and improving water quality. Vegetation filters sediment and aids in floodplain development, improving floodwater retention and groundwater recharge. Deep soil-binding root masses stabilize stream banks against erosion. Stream channels develop to provide diverse ponding and channel characteristics that support enhanced water quality, fish production, waterfowl breeding, and greater biodiversity.

Due to the importance of riparian and wetland areas, the BLM performs assessments of the functional condition of these areas using a method referred to as the assessment of PFC (Prichard 1998). The qualitative assessment process consists of an approach that considers the hydrology, vegetation, and erosion and deposition (water, soil, and vegetation) attributes of riparian-wetland areas. The on-the-ground condition (called PFC) refers to how well the physical processes that have been assessed are functioning. PFC is a state of resiliency that will allow a riparian-wetland area to hold together during high-flow events with a high degree of reliability. This resiliency allows an area to then produce desired values, such as fish habitat, neotropical bird habitat, or forage, over time. Riparian-wetland areas that are not functioning properly cannot sustain these values.

A riparian-wetland area is considered to be in PFC when adequate vegetation and landforms are present to:

- Dissipate stream energy associated with high-water flow, thereby reducing erosion and improving water quality
- Filter sediment, capture bedload, and aid floodplain development
- Improve flood-water retention and groundwater recharge
- Develop root masses that stabilize stream banks against cutting action
- Develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses
- Support greater biodiversity

For areas that are not functioning properly, changes have to be made that allow them to recover (e.g., acquire adequate vegetation). A change such as acquiring vegetation leads to other physical changes, which allows the system to begin to function. If a riparian-wetland area is not in PFC, it is placed into one of three other categories:

- Functional at-risk – Riparian-wetland areas that are in functional condition, but an existing soil, water, or vegetation attribute makes them susceptible to degradation.
- Nonfunctional – Riparian-wetland areas that clearly are not providing adequate vegetation or landforms to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, etc.
- Unknown – Riparian-wetland for which there is not sufficient information on to make any form of determination.

3.4.3.3. Current Condition

Riparian habitats in the planning area are generally dominated by willow or aspen communities along foothills streams, and usually represent stringers of habitat extending below forested areas into sagebrush and grassland habitat. Most riparian habitat on public land is between higher elevation habitats on USFS lands and lower elevation private lands in the major river bottoms. Habitats occur on wetlands and streams throughout the planning area at elevations from approximately 4,000 feet to alpine areas more than 9,000 feet.

There are four types of riparian ecosystems, in the planning area – forest-dominated riparian, willow and wet site shrub riparian, moist grass/sedge/rush/riparian, and wet meadow. On the open plains, riparian systems can be found adjacent to the Powder River and Clear Creek in Johnson County, Little Powder River and Cow Creek in Campbell County, and the Tongue River, Clear Creek, and Powder River in Sheridan County. These systems contain a variety of species, including plains cottonwood, some willow, currant, chokecherry, and sedges and rushes. The mountain systems for most of these are in the south Big Horn Mountains and include the North, Middle, and South Forks Powder River, the multiple forks of Red Fork, Big Creek, Little Eagle Creek, Buffalo Creek, Poison Creek, and many more. These systems generally have more species variety, both in composition and in structure, than their plains counterparts. Species include a variety of willows, aspen, and shrub species, including gooseberry and chokecherry, and bluegrass species, sedges, and rushes. Approximately 88% of the riparian areas in the planning area are on private lands. The proportions of riparian areas in the planning area on BLM-administered public lands are 2.5% forest dominated riparian, 1.3% willow and wet shrub riparian, 3.6% herbaceous riparian, and 0.5% wet meadow.

Riparian areas support more wildlife diversity than any other habitats and are the most productive wildlife habitat type in Wyoming. Many wildlife species depend on these habitats for all or part of their life-cycles; some are present in no other habitat types (for example, certain plant and bird species, amphibians and turtles), while other wildlife species such as shorebirds, waterfowl, and weasels frequent these habitat types. These small but important ecosystems serve as a biological oasis and represent a vegetative structure, soil, and hydrology that is unique relative to the vast expanses of sagebrush and prairie grass that dominate the landscape of the region. Riparian habitats support extended forb production and diversity in vegetation and structural complexity that provides for biological communities rich in insect composition. Emerging aquatic insects are a large part of the diet of birds using riparian areas. These factors make riparian areas the most important habitats to avian biodiversity across the West. Upland game birds, raptors, and migratory birds do not depend solely on riparian systems for cover or as a direct food source, but do depend on those areas as sources of water for consumption. Greater Sage-Grouse, for instance, depend on riparian areas in the summer for late brood-rearing habitat. After upland forbs have expired, Greater Sage-Grouse move into riparian habitats, as forbs generally are still available in these areas for several more months. Small mammals residing close to water sources provide a secondary food source for upland game birds, raptors, and migratory birds. Raptors will inhabit these areas if cottonwoods, alive or dead, are present for perching and nesting.

Riparian areas are ecosystems that have distinct vegetation and soil characteristics. Riparian ecosystems are uniquely characterized by the combination of high species diversity, high species densities, and high productivity. Typical plant species present in riparian and wetland communities in the planning area include cottonwoods, willows, rushes, sedges, redtop, bluegrass, saltgrass, horsetail, dock species, iris, wild licorice, arrowgrass, bulrushes, and cattails. In addition to these native plant species, several invasive species are prevalent in riparian areas in the planning area, including Russian knapweed, Canada thistle, musk thistle, houndstongue, tamarisk (salt cedar), and leafy spurge. Invasive species have been shown to decrease biological diversity, affect stream functions, degrade the quality of wildlife habitat, and decrease forage production for livestock and wildlife. See the *Invasive Species and Pest Management* section of this chapter for more information.

Forest Dominated Riparian

In the planning area, forest dominated riparian areas are usually characterized by cottonwood species, but can also be aspen, boxelder, or a variety of conifer species. Deciduous tree species generally dominate at lower elevations in the planning area, whereas conifers and aspen dominate the higher elevations. Trees must occupy more than 25% of the vegetative cover within the riparian zone to be considered forest dominated riparian.

Willow and Wet Site Shrub Riparian

These riparian areas are characterized by areas where shrubs comprise more than 25% of the vegetative cover and where trees occupy less than 25% of the total vegetative cover. Shrubs often include willow species, sagebrush species, or greasewood. Other shrubs (e.g., hawthorn, American plum, birch, alder, tamarisk, and shrubby cinquefoil) could be present or dominant. These areas include alpine riparian zones dominated by willow species or other shrubs.

Moist Grass/Sedge/Rush Riparian

This vegetative type consists of a variety of riparian moist grasses, sedges, and rushes. The herbaceous riparian vegetative type occurs near drainages, including rivers, streams, and creeks.

Wet Meadow

This vegetative type is a combination of green and very green herbaceous rangeland types as defined by the WGFD, including bluegrass, salt grass, horsetail, bulrushes, and cattails. Wet meadow is a grassland community that typically occurs on fine-textured soils. In addition, this community commonly occurs where springs emerge, along reservoirs, and in irrigated pastures (Knight 1994).

Ecosystem Types

For management purposes, the BLM separates riparian-wetland areas into those associated with flowing water (lotic) or those associated with non-flowing water (lentic).

Examples of lotic systems are creeks, streams, rivers, springs, and channels. Examples of lentic systems are ponds, basin marshes, reservoirs, seeps, lakes, and pools. Table 3.29, “Wetland Inventory Data, 2007” (p. 305) lists the results of the wetland inventories that performed in the planning area.

Table 3.29. Wetland Inventory Data, 2007

	Lentic Wetlands (acres)	Lotic Wetlands (miles)
Wetlands evaluated	533	110
Proper functioning condition	24	74
Functioning at-risk, upward trend	0	7
Functioning at-risk, downward trend	0	2
Functioning at-risk, no apparent trend	22	17
Non-functioning	103	11
Unknown	384	0
Source: BLM 2007a		

Management Challenges/Management Objectives

The BLM goal for riparian and wetland areas is to maintain, rehabilitate, and improve riparian ecosystems to achieve maximum long-term benefits in conformance with the *Buffalo Resource Area Wetland Habitat Management Plan*. This plan was developed in cooperation with WGFD. Management challenges for riparian and wetland communities include balancing the sometimes conflicting demands of livestock grazing and wildlife habitats; managing for PFC; protecting water quality; avoiding improper livestock grazing, especially during dry summer months without sufficient alternative water supplies; and fencing or other livestock exclusion options along riparian areas and wetlands. Placement of livestock supplements near riparian areas and wetlands could result in impacts to terrestrial, wetland, and aquatic habitats. One of the greatest challenges is managing for PFC when riparian areas and wetland systems involve different landowners with different resource objectives, and public lands are the minority surface. Because riparian and wetland areas provide all the basics for vegetation to thrive, they are also prime locations for the invasion and spread of invasive species.

Livestock grazing is the most widespread activity that influences riparian habitat conditions in the planning area. Energy development, roads, forest management, dispersed recreation, and localized wildlife impacts also affect the functional capability of riparian-wetland areas. The cumulative impacts of overlapping uses complicate the effectiveness of applying management constraints to a single activity to achieve riparian objectives.

When CBNG development reaches its peak, lentic and lotic systems in the planning areas also will reach their peak acreages. Once all the permitted wells are developed and the excess water disposed of, these CBNG-created "wet" systems will decline. When impoundments are no longer needed for excess water holding and disposal, most of these structures will be reclaimed and the artificial riparian-wetland systems created by these temporary structures will dissipate.

Because of all the benefits riparian-wetland areas offer, there needs to be more emphasis on these systems. Past restoration projects have proven these communities are quick to recover if they are currently not functioning properly. Resource programs need to analyze and adjust projects and management to minimize potential adverse impacts.

3.4.3.4. Trends

Habitat potential has been altered on many riparian areas where channel alteration has lowered the water table and reduced the extent of riparian habitat. This has altered riparian vegetation communities and allowed the encroachment of upland herbaceous species, such as sagebrush and juniper. Overcrowded woodland and forest conditions could be contributing to lower water yields and shrinking riparian zones in some areas, particularly during drought cycles. Riparian-wetlands in the planning area are anticipated to increase in acreage so long as impoundments are the primary way to address disposal of CBNG produced water. As the number of impoundments and the use of natural drainages for CBNG produced water transportation and disposal increase, the acreage of lentic and lotic systems also will increase.

3.4.3.5. Key Features

Because of the multiple high values of these systems, all riparian and wetland areas are considered key features and will be managed according to each system's values.

3.4.4. Invasive Species and Pest Management

3.4.4.1. Regional Context

In Wyoming, as in other western states, invasive species are considered the single most serious threat to natural habitats. The spread of invasive species contributes to the loss of rangeland productivity, increases soil erosion, reduces water quantity and quality, reduces species and structural diversity, the loss of wildlife habitat, and in some cases invasive species pose an important threat to multiple-use management of public land. There are currently 25 Wyoming State designated noxious weeds and six designated pests (mostly insects) (Table 3.30, "Wyoming Weed and Pest Control Act Designated List" (p. 307)). Table 3.31, "Declared List of Weeds and Pests by County in the Planning Area for 2012" (p. 307) lists the declared invasive species and pests by county in the planning area for 2012.

Table 3.30. Wyoming Weed and Pest Control Act Designated List

Noxious Weeds			
Canada thistle	Field bindweed	Perennial sowthistle	Scotch thistle
Common burdock	Hoary cress (whitetop)	Plumeless thistle	Skeletonleaf bursage
Common St. Johnswort	Houndstongue	Purple loosestrife	Spotted knapweed
Common tansy	Leafy spurge	Quackgrass	Yellow toadflax
Dalmatian toadflax	Musk thistle	Russian knapweed	-
Diffuse knapweed	Ox-eye daisy	Russian olive	-
Dyers woad	Perennial pepperweed (giant whitetop)	Saltcedar	-
Pests			
Beet leafhopper	Grasshopper	Mountain pine beetle	-
Black-tailed prairie dog	Mormon cricket	Wyoming ground squirrel	-
Source: Wyoming DOA 2008b			

Table 3.31. Declared List of Weeds and Pests by County in the Planning Area for 2012

Campbell County	
Black henbane	Common cocklebur
Buffalobur	Mosquito
Johnson County	
Buffalobur	Puncturevine
Common cocklebur	Tall mountain larkspur
Common mullein	Wild licorice
Curly dock	Varroa mites
Mosquito	-
Sheridan County	
Alfalfa weevil	Mosquito
Black henbane	Plains pocket gopher
Buffalobur	Puncturevine
Common cocklebur	Showy milkweed
Common mullein	Wild licorice
Curly dock	-
Source: Wyoming Weed and Pest Control 2008	

3.4.4.2. Indicators

The indicators of management success would be the trend of invasive species or pest persistence. Monitoring, field observation, agency input, field counts, and reporting findings are important in measuring management success.

FLPMA and the *Wyoming Standards for Healthy Rangelands* direct the BLM to manage vegetative resources toward the maintenance or restoration of the physical function and biological health of vegetative ecosystems. On public lands, the degree of impact from an invasive species depends on the type of invader (e.g., plant, insect, and parasite), the specific specie(s), the growth characteristics of that specie(s), density, size of infestation, the land cover type being invaded, the resources threatened, and the potential economic impacts to the resources and the cost of control or eradication of the invader. Some of the repercussions of weed proliferation are reduced forage, desertification of upland and riparian habitats, decreased animal health and increased mortality, devaluation of animal commodities, equipment decontamination, and reduced land values.

3.4.4.3. Current Condition

Invasive species are plants that can cause serious problems when introduced into a new environment. They have the potential to disrupt or alter the natural ecosystem function, the composition, or the diversity of the sites they occupy. Non-native species often have a competitive advantage that results from the lack of natural controls in their new environments. In areas where these species have invaded, the ecology of the area is altered, native plants that provide habitat and forage for animals are reduced or eliminated. These species can complicate the use of local natural resources and can interfere with management objectives for a site. Organisms that have been moved from their native habitat to a new location (often in a different country) are typically referred to as non-native. Most invasive species are non-native, but a distinction is made in this document because they can and do include undesirable native plants. Noxious weeds are native or non-native plants invasive species that are undesired in a particular area at a particular time, as “designated” by the State of Wyoming or “declared” by Weed and Pest Control Districts. With the exception of vascular plants classified as invasive species, a pest can be any biological life form that poses a threat to human or ecological health and welfare. To date, and only occasionally, the Buffalo Field Office has dealt with grasshoppers, Mormon crickets, mosquitoes, and predator control.

The primary invasive species being targeted on public lands include leafy spurge, tamarisk, Russian knapweed, spotted knapweed, diffuse knapweed, Scotch thistle, Canada thistle, houndstongue, Russian olive, halogeton, black henbane, dalmation toadflax, and hoary cress (whitetop). Some species, including annual bromes, plains pricklypear, and Canada thistle, have become so ubiquitous throughout the planning area that it is considered economically unfeasible to attempt to control them, and they are considered part of the vegetative landscape despite their adverse impacts to other vegetation. Canada thistle, although common throughout the planning area, is not treated on a plant-by-plant basis, but is treated when plant populations reach densities high enough to make it the majority species, when it is present in the bottom of dry reservoirs, on recreational sites, and along established roads and undeveloped vehicle trails.

Two non-native annual bromes – cheatgrass and Japanese brome – have populations that have steadily increased, invaded every type of plant community, and received minimal control treatments. These annual bromes, particularly cheatgrass, are invading grassland, sagebrush grassland, mixed grass prairie, and mountain shrub community types. These plant species are very competitive with native plants for soil nutrients and available water. Using currently approved available herbicides, funding, and methodologies, it is not economically feasible to initiate large-scale control efforts on non-native annual bromes at this time but may be feasible for small-scale acreages and specific projects.

In addition to invasive plant species, there also are invasive insects (called pests) in the planning area. These insects include slant faced grasshoppers, Mormon crickets, mosquitoes, and the mountain pine beetle. See the *Vegetation – Forests and Woodlands* and the *Fire and Fuels Management* sections for more information about the mountain pine beetle and other forest and woodland pests.

Invasive plants are present throughout the planning area. In general, road corridors and water systems (rivers and creeks) are the main sources of infestation. Infestations can occur or spread when seeds are spread by vehicles, carried by livestock or wildlife, or dispersed by water or wind. In addition, ground-disturbing activities provide open sites for these plants to invade. Control methods vary as site conditions vary and often several treatment methods are used for the same infestation. Grazing by domestic animals can be used to reduce seed production and shift the vegetation community to more desirable species.

Any vegetative community is susceptible to invasive species, but sites that are especially vulnerable include areas where soils have been disturbed and the native plant community has been displaced or destroyed. The occurrence of invasive species expansion is very high in areas of CBNG development. Roads, trails, and oil and gas locations constructed or created for energy development created new areas of disturbance and acted as vectors for transporting seeds to other locations. Utility corridors and their soil-disturbing activities also acted as a prime medium for invasive species to establish. All these disturbances occur on a variety of soils, soil depths, slopes, and in differing plant communities, making management of invasive species difficult. Construction of reservoirs and ponds and other produced-water disposal methods for CBNG development provided areas of soil disturbance and the perfect medium for establishment of invasive species, especially tamarisk. To date, approximately 400 reservoirs have been constructed on public land in association with CBNG development. These reservoirs and ponds provide breeding habitat for mosquitoes carrying West Nile virus. The use of mulch to stabilize disturbed areas is a common practice in areas of energy development; this mulch is sometimes infested with invasive species seeds. Mining areas are also disturbance locations for invasive species to establish, and transporting solid minerals can move unwanted seeds. Reclamation of energy sites provide opportunities for invasive species, as does the planting of weed-infested seed on reclamation projects. Riparian corridors also provide the perfect growing medium, including nutrient-rich soils, ample moisture, remote locations, and a moving medium to transport plants and seed. Areas of livestock confinement, wildfires, recreational sites, undeveloped vehicle trails, range improvement projects, and OHV use also can create disturbances or result in total removal of native vegetation, which makes sites and landscapes more susceptible to invasive species. Other means of invasive plant species establishment can result from plant and seed transport with purchased forage and hay for supplemental livestock feeding that is not certified weed seed-free. Expansion of ranchettes and small-acreage dwellings in rural areas also increases the opportunity for invasive species to expand onto the public lands.

Although Weed and Pest Control Districts in Johnson, Campbell, and Sheridan counties, and other BLM permitted entities are controlling invasive plant species, invasive species management objectives are not being fully met due to the scale of infestations and lack of appropriate resources.

Invasive Plant Species Control

The weed management program continually changes as a result of new weed introduction, additional inventory, and the ongoing implementation of weed management projects. The invasion and proliferation of weeds increases the costs of invasive species control. If invasive species become established, treatment can be difficult and expensive, and eradication is often impossible. Areas might require several treatments over many years with mechanical equipment, biological controls, and herbicides designed to kill the invasive species, with possible loss of native vegetation. The BLM uses a full range of integrated pest management in the planning area. Basic management involves the following:

- Early detection and rapid response (new invasive species)
- Containment and management (widespread infestations)
- Inventory, monitoring, and evaluation
- Public awareness, education, and outreach

A full inventory of invasive plant species in the planning area has never been completed. In some areas, efforts have gained substantial control and reduced the spread of certain species, such as leafy spurge. Other species, especially diffuse knapweed, Russian knapweed, white top, Russian olive, and tamarisk, which have continued to expand their populations and the number of infested acres is increasing. In addition, new invasive plant species such as Dalmatian toadflax and black henbane are beginning to appear in multiple locations in the planning area.

The BLM controls invasive plant species on public lands through cooperative agreements with the Johnson, Sheridan, and Campbell County Weed and Pest Control Districts, and with commercial applicators. In addition to the County Weed and Pest Control Districts, the BLM works in cooperation with other federal and state agencies, private landowners, and energy production companies for management of both invasive plants and pests. Control methods used include chemical, mechanical (hand pulling and mowing), biological (insects, diseases, and grazing), and cultural (revegetation, mowing, reseeding).The BLM also addresses invasive plant species management by incorporating prevention and control measures in realty, wildlife, range, recreation, and oil and gas and other mineral-related actions.

All primary invasive plant species continue to colonize new areas. Invasive plants are typically present in sagebrush-grassland, mixed grassland, and riparian-wetland community types. It is not likely that most of these invasive plant species will ever be eradicated. Large-scale energy development in the planning area will require intensive invasive species management to keep populations and infested sites to a minimum. The present goal is to contain and reduce densities of invasive species populations to levels considered manageable. The tolerance level depends on the species, location, and resources at risk. Generally, the County Weed and Pest Control Districts, and BLM have not been able to meet all the BLM invasive species management needs. According to the BLM Wyoming 2009 reclamation policy (BLM 2009f), all ground-disturbing activities will require an invasive plant management plan.

Management of annual brome species will depend on the cost and feasibility of available treatment methods. Resource management strategies, minimizing adverse impacts from wildfires, reducing wildfire fuels, constructing fuel breaks, minimizing surface disturbance and surface-disturbing activities, and other preventive measures will all contribute to maintaining current levels or reducing the expanse of annual brome species communities. Research into developing new herbicide formulations continues, as does research into the existence and effectiveness of biological agents, including pathogens, to serve as future tools in controlling annual brome species and other species that create a similar threat, such as medusahead.

Table 3.32, “Treatment of Invasive Plant Species in the Planning Area” (p. 310) lists the acreages of invasive plant species being treated annually in the planning area.

Table 3.32. Treatment of Invasive Plant Species in the Planning Area

Species Treated	Acres of Treatment per year
Leafy spurge	212
Diffuse knapweed	27
Scotch thistle	32

Species Treated	Acres of Treatment per year
Halogeton	38
Salt cedar	62
Canada thistle	43
Houndstongue	21
Common mullein	19
Source: BLM 2005 - 2008	

Pest Control

Pests – Pest species such as grasshoppers can be detrimental to all ecological sites because they chew grass stems, break the stalks, remove reproductive structures, destroy seeds, and leave the forage to die to dry matter. In addition to reducing plant production, pests can reduce the nutrient content, palatability, and serve as vectors to introduce threatening pathogens such as bacteria, spores, and viruses. Forbs and shrubs also can be directly and adversely affected if pest populations exceed their natural threshold. Control treatments are designed to reduce pest populations to natural or economic thresholds, not complete eradication. In an average year, pests are negligible; however, populations above economic thresholds cycle every 7 to 10 years and can last approximately 3 years. The effects of these cycles can be minor to moderate. Insecticides are effective in controlling pest populations.

The mountain pine beetle is native to the forests of western North America. Outbreaks develop regardless of property lines, and are equally evident in wilderness areas, mountains, back yards, and windbreaks. Landscape pines many miles from the mountains can succumb to beetles imported in infested firewood. Mountain pine beetles develop in pines, particularly ponderosa, lodgepole, Scotch, and limber pine. Attacks are limited largely to trees under stress from injury, unhealthy ecological states, fire damage, overcrowding, root disease, or old age. A key part of the infestation is the ability of mountain pine beetle (and other bark beetles) to transmit bluestain fungi. Spores contaminate the bodies of adult beetles and are introduced into the tree during attack. Fungi grow in the tree and help the beetle kill the tree. The fungi give a blue-gray appearance to the sapwood. Once mountain pine beetles infest a tree, nothing practical can be done to save that tree. Chemical control options for mountain pine larvae have been greatly limited in recent years. At present, there are no labeled pesticides for use on the mountain pine beetle (Leatherman et al. 2011).

West Nile Virus – West Nile virus (WNv) is a mosquito-borne disease that can cause encephalitis or brain infection. WNv is expanded from infected mosquitoes that produce their young in standing water.

Since its discovery in 1999 in New York, WNv has become established and spread across the United States. Birds are the natural vector host and serve not only to amplify the virus, but to spread it. Though less than one percent of mosquitoes are infected with WNv, they still are very effective in transmitting the virus to humans, horses, and wildlife. *Culex tarsalis* appears to be the most common mosquito to vector WNv.

Although most of the attention focused on human health issues, WNv had an impact on vertebrate wildlife populations. In 2003, at the Smithsonian Environmental Research Center, scientists disclosed WNv had been detected in 157 bird species, horses, 16 other mammals, and alligators (Marra et al. 2004). In the eastern U.S., avian populations have incurred very high mortality, particularly crows, jays, and related species. Raptor species also appear to be highly susceptible to WNv. In 2012, seven human, four avian, and five equine cases were reported in Wyoming

(Wyoming Department of Health 2012). Although the number of fatal cases reported for bird species was low in Wyoming, actual mortality is likely to be greater.

The avian WNv cases reported in Wyoming in 2012 included Greater Sage-Grouse, red-tailed hawk, and Swainson's hawk (Wyoming Department of Health 2012). Population impacts of WNv on raptors are unknown at present, yet the species may be quite susceptible to the disease (Wesenberg et al. 2012). The Wyoming State Veterinary Lab determined 22 Greater Sage-Grouse in one study project (90% of the study birds), succumbed to WNv in the Powder River Basin in 2003. Current evidence demonstrates that Greater Sage-Grouse have little biological resistance to the virus and the effects are usually fatal.

Surface water issues from CBNG-related water disposal, livestock water facilities, and natural ponds have complicated West Nile virus control efforts. These pits, which number in the thousands, were created to hold CBNG produced waters. The most common control method in the planning area is the use of bacteria in biological control, which has proved to be quite successful. *Bacillus thuringiensis israelensis* (Bti) has been very effective as a larvicide. It was approved by the EPA in 1981 as effective on 30 species of mosquitoes. The bacterium does not harm other aquatic life or mammals, but results in a 90% to 100% kill on most types of mosquito larvae. Larvae eat Bti when it is sprayed over water. Knockdown activity begins within a few hours, and total kill takes place within 24 hours. Bti will remain active in the water for up to 3 days; after that, it too will die. Bti does not endanger the ecology of the area by persisting and reproducing and it is effective only on larvae. Altosid® is a commonly used larvicide that contains the active ingredient methoprene, an insect growth regulator. It commonly comes in a briquette, pellet, or granular form and is designed to release effective levels of methoprene over a period of up to 150 days as the briquettes dissolve. Larvae in treated waters continue to develop normally to the pupal stage, but at this stage, they are affected by the chemical and die.

Quagga and Zebra Mussels – Aquatic invasive species are non-native organisms that can cause great harm to an ecosystem. Aquatic invasive species like quagga mussels and zebra mussels are small organisms that could have major adverse effects on Wyoming's waters, boaters, and anglers. These species are able to multiply quickly and form thick, dense clusters that can impede water delivery and increase maintenance costs to power plants, municipalities, irrigation systems, and other water users by clogging pipes, pumps, turbines, and filtration systems. Fisheries are destroyed by the presence of these invasive filter-feeding mussels. Quagga and zebra mussels remove plankton from the water; plankton are the primary food source for forage fish, and forage fish are the food of sport fishes. Treatment options are few and expensive; the best treatment is prevention. This species has not yet been found in the State of Wyoming, but due to their potential adverse impacts, large-scale education and awareness efforts are ongoing. The mussels are most likely to be found in larger waterbodies, but could be found in ponds and reservoirs on public lands.

Pest management depends on whether there is a health or economic risk due to the presence of pests. In February 2003, the USDA Animal and Plant Health Inspection Service (APHIS) and the BLM signed a memorandum of understanding (MOU) detailing cooperative efforts between the two entities on suppression of grasshoppers and Mormon crickets on BLM-administered lands (BLM 2009g). This MOU clarifies that APHIS prepares and issues to the public site-specific environmental documents that evaluate potential impacts associated with proposed measures to suppress economically damaging grasshopper and Mormon cricket populations. The MOU also states that these documents will be prepared under the APHIS NEPA implementing procedures with cooperation and input from the BLM. The MOU further states that the responsible BLM official will request in writing the inclusion of appropriate lands in the APHIS suppression project when treatment on BLM-administered land is necessary. The BLM must also approve a Pesticide Use Proposal (Form FS-2100-2) for APHIS to treat infestations. According to the provisions of the MOU, APHIS can begin treatments after the appropriate decision document is issued and the BLM approves the Pesticide Use Proposal.

The preferred method for treating grasshoppers and Mormon crickets is by Reduced Agent Area Treatments (RAATs). RAATs are a grasshopper suppression method in which the rate of insecticide is reduced from conventional levels, and treated swaths are alternated with swaths that are not directly treated. The RAATs strategy relies on the effects of an insecticide to suppress grasshoppers within treated swaths while conserving grasshopper predators and parasites in swaths not directly treated. Grasshopper and Mormon cricket treatments occur on a 7- to 10-year cycle and occur for 1 to 3 years concurrently in the planning area.

Management challenges for invasive species include managing BLM-authorized activities in the planning area that disturb the soil or otherwise create an opportunity for the establishment of invasive species, especially in the CBNG development areas, the interstate corridors, the larger river and creek corridors, and other watersheds. Other challenges include educating resource specialists and users, early detection for rapid response, and diminishing funding. These challenges require coordination across all of BLM resource programs to develop, integrate, and implement aggressive management techniques and the strategies for controlling the adverse impacts and the spread of invasive species in the planning area.

See the *Vegetation – Forests and Woodlands* and the *Fire and Fuels Management* sections of this document for more information on mountain pine beetle and other forest and woodland pests.

3.4.4.4. Trends

Mosquito control will continue in an effort to reduce the transmittal of West Nile virus to wildlife and human health and safety.

Historically, the highest populations of grasshoppers and Mormon crickets are south of Kaycee, Wyoming, from Salt Creek west to the Hole-In-the-Wall. Grasshopper populations have also been at levels capable of forage destruction northeast of Buffalo, Wyoming, between Clear Creek and Crazy Woman Creek.

3.4.4.5. Key Features

Key features for invasive species include areas of known infestations identified on County Weed and Pest Control Maps, and areas of potential infestations, including CBNG and associated developments, riparian zones, and transportation and utility corridors.

3.4.5. Fish and Wildlife Resources – Fish

3.4.5.1. Regional Context

Riparian and wetland habitat conditions in the planning area are described under *Vegetation – Riparian/Wetland Resources*. The *Water* section of this chapter provides information about surface-water bodies, water quality, and water quantity.

There are approximately 46 fish species in the planning area (Table 3.33, "Fish Species Known to Occur and Their Preferred Habitat in the Planning Area" (p. 314)). The planning area is centrally located within the distribution ranges for fourteen of these species (yellow perch, walleye, rainbow trout, smallmouth bass, green sunfish, golden shiner, common carp, channel catfish, brown trout, brook trout, bluegill and black crappie), on the eastern edge of the distribution ranges for ten of these species (Yellowstone cutthroat trout, Snake River cutthroat trout, sand shiner, mountain whitefish, mountain sucker, longnose sucker, longnose dace, lake chub, and Arctic grayling), and on the western edge of the distribution ranges for 22 of these species (white sucker, white crappie, western silvery minnow, sturgeon chub, stonecat, shovelnose sturgeon, sauger, rock bass, river carpsucker, plains topminnow, plains minnow, shorthead redhorse, grass carp, goldeye, flathead chub, finscale dace, fathead minnow, emerald shiner, creek chub, brook stickleback, brassy minnow, and black bullhead). There are few fish-bearing streams on BLM-administered lands due to the fragmented land ownership pattern. Most fish-bearing streams occur on lands under state or private ownership. Where fish-bearing streams do occur on public lands, they generally occur on small isolated land parcels. The *Special Status Species – Fish* section of this chapter describes special status fish species, including federally listed fish species. Species identified by the WGFD as a priority for management include 16 fish species classified as Native Species Status (NSS) 1 to 4 (see Appendix K (p. 1749)).

Table 3.33. Fish Species Known to Occur and Their Preferred Habitat in the Planning Area

Common Name	Preferred Habitat
Arctic grayling	Alpine lakes and streams
Black bullhead	Small muddy lakes; pools in large and small streams
Black crappie	Lowland lakes, pools, and backwaters in rivers
Bluegill	Lowland lakes, pools, and backwaters in rivers
Brassy minnow	Weedy streams; clear creeks with sand and gravel bottoms; lakes (occasionally)
Brook stickleback	Lowland lakes, pools, and backwaters in rivers
Brook trout	Small, cold stream and beaver ponds; mountain lakes and plains lakes (occasionally)
Brown trout	Larger foothill streams with slower moving waters
Channel catfish	Large clear rivers (can tolerate turbid water)
Common carp	Lakes, pools, and backwaters in rivers
Creek chub	Clear, gravel bottomed creeks
Emerald shiner	Lowland reservoirs
Fathead minnow	Slow-flowing, weedy streams, and shallow lakes and ponds
Fine scaled dace	Small streams and lowland ponds
Flathead chub	Large silty rivers
Golden shiner	Lowland lakes, pools, and backwaters in rivers
Goldeye	Lakes and streams (adapted for turbid conditions)
Grass carp	Reservoirs
Green sunfish	Pools in small to medium-sized streams; small lakes, ponds, and sloughs
Lake chub	Cool streams and lakes
Lake trout	Cold, deep lakes and reservoirs
Largemouth bass	Ponds and reservoirs
Longnose dace	Riffle areas in streams and rivers
Longnose sucker	Clear, gravel bottomed creeks
Mountain sucker	Clear, gravel bottomed creeks
Mountain whitefish	Prefers deep, fast water in large, clear cold rivers. Sometimes abundant in lakes.
Shorthead redhorse	Large, turbid streams and rivers
Northern plains killifish	Large, turbid streams and rivers
Plains minnow	Large, turbid streams and rivers

Common Name	Preferred Habitat
Plains topminnow	Lowland streams
Pumpkinseed sunfish	Pools in small to medium-sized streams; small lakes, ponds, sloughs, and lakes.
Rainbow trout	Large foothill streams, ponds and reservoirs
River carpsucker	Large, turbid streams and rivers
Rock bass	Streams, pond, and reservoirs
Sand shiner	Large, turbid streams and rivers
Sauger	Large, turbid streams and rivers
Shovelnose sturgeon	Large, turbid streams and rivers
Smallmouth bass	Streams, ponds, and reservoirs
Snake River cutthroat trout	Relatively clear, cold creeks, rivers, and lakes at temperatures between 4 and 15°C
Splake	Alpine and lowland lakes and reservoirs
Stonecat	Turbid streams and rivers
Sturgeon chub	Large, turbid streams and rivers
Tiger musky	Lowland lakes and reservoirs
Tiger trout	Cold streams, ponds, lakes, and reservoirs
Walleye	Lowland lakes, reservoirs, and larger lowland streams
Western silvery minnow	Large, turbid streams and rivers
White crappie	Lowland lakes, pools, and backwaters in rivers
White sucker	Streams, ponds and reservoirs
Yellow perch	Lowland lakes, pools, and backwaters in rivers
Yellowstone cutthroat trout	Relatively clear, cold creeks, rivers, and lakes at temperatures between 4 and 15°C
Source: WGFD 2012 °C degrees Celsius	

3.4.5.2. Indicators

Vegetation in riparian zones serves to dissipate stream energy, store water for later release, provide areas for groundwater infiltration, and provide rearing areas for juvenile fish. Riparian vegetation occurring along drainages also serves to moderate water temperatures, control erosion by adding structure and stability to stream banks, provide in stream habitat for fish, and provide organic material and nutrients to aquatic biota. In addition to physical habitat features such as vegetation, water quality also influences aquatic habitats. Specifically, water temperature, turbidity, dissolved oxygen, and TDS or salinity determines the quantity and quality of aquatic habitats. Other factors influencing aquatic habitats in the planning area include adjacent land uses and the locations of such habitats in relation to natural landscape features.

Fishery habitat conditions are closely tied to riparian conditions and water quality. Riparian vegetation moderates water temperatures, increases bank stability, supports insects used as important food source, filters sediment, provides in stream habitat for fish, and provides organic material for aquatic invertebrates. Water development that alters discharges, turbidities, water temperatures, and sediment transport will likely result in a change to the endemic fish community. The following are indicators of the overall health of fisheries: population densities, water quality, water quantity, bank cover, insect/macroinvertebrate populations, habitat quality, gain or loss of important habitats, rangeland health standards, riparian PFC ratings, and/or disease occurrence/impacts.

Development of energy and mineral resources in the Powder River (Energy) Basin of northeastern Wyoming and southeastern Montana includes rapid expansion of CBNG development in Wyoming. Changes in flow regime and water quality wrought by CBNG development in the upper

Cheyenne River basin have the potential to affect stream and riparian environments (Barrineau et al. 2007). Small irrigation diversion structures and impassable road crossings fragment habitat and could be interfering with some life-cycle requirements of some native fish species. Improving and maintaining water quality in streams and rivers, and improving the conditions of riparian habitats are key components to managing aquatic resources throughout the planning area.

The Aquatic Task Group developed a monitoring plan to meet two main objectives: (1) establish current ecological conditions for aquatic biota and their habitat, and (2) determine existing and potential effects of CBNG-produced water on aquatic life (Peterson et al. 2011). In response to this monitoring effort, an ecological assessment of streams in the Powder River Basin was performed by the USGS in cooperation with the BLM, the Wyoming DEQ, the WGFD, the EPA, the Montana DEQ, and Montana Fish Wildlife and Parks to determine current (2005 to 2008) status and to establish a baseline for future monitoring and reporting (Peterson et al. 2010). On the basis of the 2005 to 08 results, sampling of the microinvertibrate and algae communities was conducted at 18 sites on the mainstem Powder River and six sites on the mainstem Tongue River in 2010. The data collected (and incorporated in the previous sections) provides a snapshot of conditions in streams of the Powder River Basin during 2005 to 2008, and again in 2010, and can be used in conjunction with future monitoring to assess the impacts of CBNG and other development. Additional data analysis tools might also warrant further investigation (Peterson et al. 2010).

3.4.5.3. Current Condition

The planning area encompasses all or parts of 15 fourth-order watersheds (sub-basins). The USGS National Hydrography Dataset was used to identify these basins and the rivers, streams, and reservoirs within them (Table 3.34, “Basins and Corresponding Sub-Basins” (p. 316)). Portions or all of these sub-basins are included in WGFD Water Basin Management Plans. The *Water* section of this chapter provides additional details about the sub-watersheds. Descriptions of the existing conditions for the Powder River Basin, Tongue River Basin, Belle Fourche River Basin, Little Bighorn River Basin, Little Missouri River, and Cheyenne River Basin follow.

Table 3.34. Basins and Corresponding Sub-Basins

Basin (Acres BLM Surface) (Third-Order HUC)	Corresponding Sub-Basins in the Planning Area (Fourth-Order HUC)
Powder River 594,277	Upper Powder Salt Middle Powder South Fork Powder Middle Fork Powder Crazy Woman Clear Little Powder
Tongue River 150,772	Upper Tongue
Cheyenne River 34,856	Antelope Upper Cheyenne
Belle Fourche River 29,307	Upper Belle Fourche
Bighorn River 1,788	Little Bighorn River Nowood

Basin (Acres BLM Surface) (Third-Order HUC)	Corresponding Sub-Basins in the Planning Area (Fourth-Order HUC)
Little Missouri River 407	Upper Little Missouri
Source: EPA 2012 BLM Bureau of Land Management HUC Hydrologic Unit Code	

Powder River Basin

The Powder River is a rare example of a free-flowing prairie stream. There are no dams over its entire length. There are, however, areas identified as potential hydroelectric sites along the Powder River. Including tributaries, the drainage basin encompasses 8,000 square miles. There are eight fourth-level hydrologic unit codes (HUCs) for the Powder River Basin in the planning area. The Powder River is formed by the confluence of the North Fork Powder River and the Middle Fork Powder River near Kaycee, Wyoming (WGFD 2008c). Fifty-two additional intermittent or ephemeral tributaries drain into the Powder River.

The Powder River is a low-gradient meandering stream with highly fluctuating flows, high turbidity, and a very unstable sand bottom (Hubert 1993). It is naturally turbid and saline because of its flows through erodible sedimentary material. The Powder River has a typical snowmelt hydrograph, driven by accumulations in the southern Big Horn Mountains. Flow variation is naturally high and is exacerbated by irrigation withdrawals from the tributaries of the drainage. The river is generally shallow and contains portions of a shifting streambed composed of fine sands and clays that provide minimal habitat for aquatic invertebrates. Low light penetration through the turbid water also contributes to low aquatic invertebrate production by inhibiting vegetation growth (W.H. Bradshaw 1996).

Virtually all of the bottomland and riparian areas of the Powder River Basin are privately owned. Public lands, consisting mainly of sagebrush or grasslands in uplands adjacent to the river, are managed by the BLM and are concentrated in the Powder River Basin about midway down the Powder River and in the upper reach of the South Fork Powder River (W.H. Bradshaw 1996). Historically, the Powder River Basin was used extensively and almost exclusively for cattle and sheep grazing. Oil and gas developments and recently developed coal mines have become dominant land uses over the past 80 years (W.H. Bradshaw 1996).

Twenty-eight fish species are present in the Powder River Basin. The game species in the Powder River and its tributaries include black bullhead, channel catfish, stonecat, small-mouth bass, rock bass, green sunfish, shovelnose sturgeon, sauger, and walleye (Hubert 1993). Native stream-dwelling game fish in the Powder River Basin are channel catfish, sauger, shovelnose sturgeon, and stonecat. Stonecat are rarely targeted for angling, and virtually all fishing is directed at the other three species. Channel catfish, sauger, and shovelnose sturgeon occur most commonly below the mouth of Crazy Woman Creek as seasonal migrants from Montana. There is little information about angling on streams in the Powder River (proper), but it is assumed that virtually all effort is expended on channel catfish, sauger, and shovelnose sturgeon on the lower Powder River. Gerhardt and Hubert (1991) estimated the annual exploitation rate of channel catfish to be only two percent, indicating very low overall fishing pressure.

The preservation of historical flows, turbidity, and water quality in the Powder River is an important factor in preserving the unique species assemblage. The endemic species have evolved life histories that enable them to survive in these unique conditions (Hubert 1993). Within the Powder River proper, extreme fluctuation of streamflow and temperature, low aquatic invertebrate production, high turbidity and dissolved solids, and an unstable streambed limit the population of most game fish. Consequently, sport fish management options are limited.

Some intermittent or ephemeral tributaries to the Powder River have received more constant flows since CBNG produced water discharges began. Salt Creek is a major tributary of the Powder River and during low-flow periods contributes most of the flow to the Powder River. Streamflows in Salt Creek are augmented by water discharged from oil and gas wells drilled in the Salt Creek Field near Midwest, Wyoming. This water contains elevated levels of TDS, chlorides, sulfates, and sodium. Depending on the time of year, these constituents can be diluted quickly after Salt Creek joins the Powder River or could retain elevated levels during low-flow periods. Although fish in Salt Creek apparently do not suffer from elevated chemical constituents or the small amounts of oil in the water, toxicity for zooplankton (*Cereodaphnia spp.*) and fathead minnows has been documented (W.H. Bradshaw 1996). According to the Wyoming Oil and Gas Conservation Commission website, CBNG development has increased most dramatically in the Powder River Basin.

Standing waters in the Powder River Basin consist mainly of small (fewer than 10 acres) reservoirs and farm ponds. Many of these ponds were created with federal funds during and after the drought of the 1930s (Mueller and Rockett 1958). Some ponds were stocked privately before World War II, but stocking increased later as federal hatcheries began producing more warm-water fish. The WGFD began stocking farm ponds in 1950 where “reasonable” public access was agreed to by the landowner. Because of inconsistency among landowners providing public access to WGFD-stocked reservoirs, cutbacks in the WGFD culture system, and availability of fish from commercial sources, the WGFD generally discontinued stocking of farm ponds in 1995. Various trout species, channel catfish, and largemouth bass are the most common species privately stocked, but green sunfish and black bullhead have undoubtedly been introduced to some ponds where they probably support very little angling.

The WGFD Powder River Basin Management Plan identified that the primary concern for the Powder River was the abundance and proliferation of invasive plant species in the riparian corridor and along adjacent upland terraces. Primary invasive species included tamarisk, Russian olive, leafy spurge, and Russian knapweed. Exotic annual grasses (Japanese brome and cheatgrass) were abundant in upland sites on river terraces. Cottonwood regeneration was sporadic, but evident in many segments of the corridor. Active down-valley meander migration processes are evident along the corridor (WGFD 2008c).

The Little Powder River covers 1,836 square miles in Northern Campbell County and is host to native and non-native warm-water fishes, comprising a sub-sample of Powder River fishes. Larger-bodied native game species may occupy the main stem Little Powder River only seasonally (Barrineau et al. 2007). The Little Powder River was classified as having an expected fish community and relatively intact habitat with minimal human influence (Barrineau et al. 2007; Peterson et al. 2010). Barrineau et al. (2007) identified the biggest concern for native species conservation as the establishment of non-native piscivorous fishes (e.g., green sunfish). Ten percent of the basin is public land, including National Grasslands, BLM-administered land, and State of Wyoming land. Land use in the basin is primarily livestock grazing with hay production in the valleys (Stewart 1996).

Tongue River Basin

The Tongue River Basin covers 1,579 square miles and includes 145 streams; the Tongue River flows for 588 miles. There is one fourth-level HUC from this basin in the planning area. In addition to numerous small tributaries, there are five major streams in the basin – North Tongue River, South Tongue River, Little Goose Creek, Big Goose Creek, and Prairie Dog Creek. Most of the basin is in Sheridan County, but a few headwater streams of the Little Goose and Big Goose drainages are in Johnson County. Elevations in the Tongue River basin range from 11,700 feet in the Cross Creek drainage to 3,470 feet where the Tongue River leaves Wyoming.

The headwaters of the Tongue River drainage originate on the east side of the hydrographic divide of the Bighorn National Forest. After the North and South Tongue rivers join to form the main stem Tongue River, the flow is primarily east and north until the Tongue River enters Montana. The area surrounding the North and South Tongue rivers is predominantly conifer and alpine meadows with extensive willow complexes in some riparian areas. The Tongue River flows through a canyon for several miles before it exits onto the plains near the Bighorn National Forest boundary at the town of Dayton. From Dayton to the state line, it flows through an alluvial floodplain. Land use on this floodplain is predominantly agriculture, but there also is residential development and one coal mine (WGFD 2008d).

Land ownership in the headwaters of the Tongue River Basin primarily consists of Bighorn National Forest, of which 55 square miles are Cloud Peak Wilderness. As the basin progresses north and east, land ownership comprises a mixture of state, BLM, and private lands. Standing waters in this basin are primarily privately owned ponds, many of which are unsuitable for supporting fish populations.

The assemblage of fish in the Tongue River Basin in north-central Wyoming is diverse. Thirty-four fish species have been documented in the Tongue River Basin. Seventeen fish species have been introduced to the basin as sport fish or forage to support the sport fisheries (the Snake River cutthroat and arctic grayling are native to Wyoming, but not to the Tongue River Basin). Streams in the headwaters contain Snake River cutthroat, Yellowstone cutthroat, rainbow, brown, and brook trout, whereas a reach of the lower river contains sauger and smallmouth bass. The South Tongue and North Tongue rivers are conducive to natural reproduction of trout. There is suitable spawning habitat for sauger, smallmouth bass, channel catfish, stonecats, rock bass, mountain whitefish, and other native and non-native nongame species in the Lower Tongue River (WGFD 2008d). Although some of these streams support suitable trout spawning habitat, much of this drainage basin supports native and non-native game fish.

Stocking plays a large role in the Tongue River Basin and most waters in the basin have been stocked at one time. North Tongue River and Bull Creek are currently stocked with Yellowstone cutthroat and Snake River cutthroat trout to augment natural reproduction. Both strains of cutthroat are stocked to determine which strain will perform the best. Before 2006, the Auburn strain of Snake River cutthroat trout was stocked in the North Tongue River and Bull Creek. This strain became established (they did not leave this stretch of river), grew large, and provided excellent fishing. However, the Auburn strain Snake River cutthroat trout became domesticated and homogenized; therefore, stocking efforts were abandoned.

The absence or scarcity of deep pools in several of the headwater tributary streams limits the habitat diversity and potential for populations of larger fish. Sedimentation limits natural production of fish and macroinvertebrates in many streams, especially the Upper North Tongue River. In the Goose Creek drainage, riparian areas and stream habitat conditions vary widely from excellent to very poor and are determined largely by individual landowners. Impacts occur from livestock grazing, irrigation withdrawals, irrigation return flows, and real estate and road development. Big Goose Creek, Little Goose Creek, and Goose Creek are channelized through Sheridan. The ability of streams to support trout becomes progressively less as they approach the downstream end of the basin.

Several irrigation and municipal water supply reservoirs have been built in the Tongue River Basin to support Sheridan and surrounding communities. Fluctuations from these reservoirs limit fisheries potential in the reservoirs and could act adversely on the wild populations of trout in the streams below these reservoirs (i.e., when flows are turned off, it adversely affects downstream fisheries).

Irrigation diversions reduce flows on many streams, and these reduced flows usually occur during critical life stages of fish and macroinvertebrates. From Interstate 90 downstream to the Montana border, irrigation diversions form barriers impede seasonal upstream movements of channel catfish, sauger, smallmouth bass, and certain nongame species. Fish, especially channel catfish, move downstream in fall and winter to the Tongue River Reservoir in Montana, and the barriers impede upstream movement during spring (WGFD 2008d).

Construction of Tongue River Reservoir, several other diversions in Montana along the Tongue River, and the Welch diversion has altered sauger migrations in the Tongue River. It is assumed that sauger historically migrated from the Yellowstone River up the Tongue River and possibly as far as Goose Creek. Walleye introductions in Tongue River Reservoir might eventually contribute to the demise of this isolated population as well, but it is not known if the walleye and sauger in Tongue River Reservoir hybridize.

Several habitat improvement projects involving in stream structures, boulder placement, and protection of eroding banks have been completed in the Tongue River Basin with the main goal of improving survival of stocked and wild fish and to increase wild trout production. Streams where habitat improvements have been completed include Bull Creek, the North Tongue River, the South Tongue River, Big Willow Creek, and Fool Creek (refer to Binns 2004 for more description of these projects). Recently, stream habitat improvements have been completed on the South Tongue River at the Dead Swede campground.

Logging, livestock grazing, and road building have accelerated the natural erosion process that contributes silt to the system. As the major streams flow off of the Big Horn Mountains and onto the plains, land use is primarily agricultural (hay, crops, and pastureland), but residential development, coal mining, and CBNG extraction are also present in the basin. According to the Wyoming Oil and Gas Conservation Commission website, CBNG development has increased in the Tongue River Basin.

Little Bighorn River Basin

The Little Bighorn River Basin, encompassing 298 square miles, contains some of the most remote waters and fish populations in the planning area. There are two fourth-level HUCs from this basin in the planning area. Elevations in the basin range from almost 10,000 feet at Boyd Mountain to less than 4,000 feet near the Montana State line on Pass Creek. The Little Bighorn River sub-watershed in the planning area is at the northern tip of the basin and is exclusively located in the lower elevations. It contains portions of a few small watercourses, such as Lodgegrass Creek, Stockade Creek, East Pass Creek, West Pass Creek, and East Twin Creek.

The topography of the Little Bighorn River Basin is variable. The upper drainage is mountainous, with deeply incised canyons, coniferous forest, and alpine meadows. At lower elevations, the topography consists of rolling hills and valleys used primarily as irrigated hay and livestock pasture (McDowell 1996). The Little Bighorn River Basin is mostly comprised of public lands (79% between BLM, state, and USFS) and only 21% private lands. Land use practices in the basin include cattle grazing, forest management, recreational gold mining, fishing, and hunting. The privately owned, lower elevations in the basin are primarily used for irrigated hay meadows and livestock pastures. Nine fish species have been documented in the Little Bighorn River Basin. Of those, three are non-natives introduced as game species. Six species are native to Wyoming; however the Snake River cutthroat is not native to the Little Bighorn River Basin.

Most streams in the Little Bighorn River Basin have been stocked at one point. Early records indicate that brook trout were stocked in 1895 from the Sheridan Branch Hatchery on Wolf Creek (Bradshaw et al. 2008). Stocking records from the WGFD dating back to the 1930s indicate that several streams were stocked annually. Previous stockings included brook, brown, rainbow, lake, Snake River cutthroat, and Yellowstone cutthroat trout, and grayling.

Lodgegrass Creek has been historically stocked with rainbow trout, cutthroat trout, and brook trout. East Pass and West Pass creeks have historically been stocked with rainbow trout, brook trout, and brown trout. Gay Creek, a tributary to West Pass Creek, might be capable of supporting trout, but none were found during the last recorded survey in 1982 (McDowell 1996). Stockade Creek, a tributary to Gay Creek, has limited habitat for trout because of high turbidity and warm water. Flow in Twin Creek, a tributary to East Pass Creek, is insufficient to support trout. Electrofishing surveys in 1958 found small dace, fathead minnows, and numerous suckers and cyprinids (McDowell 1996).

Fish habitat enhancements and improved livestock management in the Dayton Meadows portion of the Little Bighorn River and Lick Creek have substantially increased fish habitat availability. On the Little Bighorn River at Dayton Meadows, the USFS installed a series of 21 stream improvement structures in 1980. Past mining, heavy livestock use, and public use affected the stream channel and increased sediment deposition. The deeper water and overhead cover provided by the structures was beneficial in increasing the wild brook trout population (Rockett 1983). From 1995 through 1996 new habitat improvements were completed that added to, and improved upon, the 1980 work, and expanded the area treated. Phase two of the Dayton Meadows project added 1.25 miles of improved stream habitat with the addition of 33 structures (Binns 2004). From 1984 through 1986, in the meadow area of Lick Creek just downstream of USFS Road 15, 4,276 feet of stream was improved with the installation of 47 habitat structures. In 1993, the USFS installed cattle exclosures in three segments of stream to minimize impacts from cattle. The combination of habitat structure installation and protection from the impacts of livestock has increased the potential trout production of this stream (Binns 2004). In the fall of 2007, Red Gulch Creek was treated with rotenone to remove brook trout and to increase Yellowstone cutthroat trout occupation. Approximately 1.3 miles of creek was treated, with the goal of increasing Yellowstone cutthroat trout occupation from 0.3 mile to 1.6 miles. Livestock grazing, agriculture, irrigation, and oil and gas development have had the greatest impact on selected segments of the basin, particularly the riparian meadows of the Little Bighorn River, Dry Fork of the Little Bighorn River, and Lick and Lake creeks.

Cheyenne River Basin

The Cheyenne River Basin includes 6,807 square miles of the northern two-thirds of Converse and Niobrara counties, the southern two-thirds of Weston County, and the southeast corner of Campbell County. Two fourth-level HUCs from this basin are in the planning area. The basin encompasses the southern end of the Black Hills, the breaks of the Rochelle Hills south of Gillette, and the rolling hills and grasslands north of Lusk. Elevations range from 3,500 feet, where the river enters South Dakota, to 6,000 feet, in the sand hills of Converse County. The drainage basin contains four sub-watersheds (Antelope Creek, Upper Cheyenne River, Dry Fork Cheyenne River, and Lightning Creek) within Campbell and Converse counties. The Cheyenne River is free-flowing in Wyoming, but dammed at Angostura Reservoir in South Dakota. There are no natural lakes in the basin, but ponds and reservoirs are common.

Sagebrush and grasslands are the predominant vegetative types in the basin, with ponderosa pine in the Black Hills and Rochelle Hills (B. Bradshaw 1996). Most of the Cheyenne River and its tributaries flow through erodible shales, claystones, sandstones, and bentonite deposits of the Belle Fourche, Arikaree, White River, and Pierre formations (Lageson and Spearing 1988). Consequently, most streams are turbid, especially during runoff or after storm events. Turbidity prevents light penetration needed for growing aquatic vegetation, channel instability, and high temperatures probably inhibiting aquatic macroinvertebrate production and creating an environment hostile to fish species that are not adapted to such conditions (e.g., game fish) (B. Bradshaw 1996). Exceptions to this general condition are streams originating in the western Black Hills, which is an area composed of less erosive formations. The hydrograph for the Upper Cheyenne River is driven by low-elevation accumulations of snow, seasonal rainfall, and periodic storms. Flows cease during most years near the South Dakota State line. The repeated withdrawal, warming, and return of irrigation water undoubtedly contributes to high water temperatures that reach 70 °F to 80 °F during summer.

About 75% of the Cheyenne River Basin is in private ownership, 11% is in the Thunder Basin National Grasslands, eight percent is owned by the state, six percent is BLM-administered land, and less than one percent is in the Black Hills National Forest. CBNG development, recreation, forest management, bentonite mining, oil and gas production, and livestock grazing are dominant uses of public lands, while grazing and hay production are the major uses of private lands. Streams on public lands are typically small, intermittent, or do not support game fish, and provide very little fishing opportunity. Most fishing occurs on small ponds in the Thunder Basin National Grasslands (e.g., Turner and East Iron Creek reservoirs and Upton ponds) and private reservoirs where unrestricted public access is provided (Black Hill Power and Light reservoir) or where free permits are used to control access (LAK and MW reservoirs).

The Cheyenne River basin supports 30 fish species, 11 of which are native. Creek chub were expected but not sampled from the basin, while mountain sucker were unexpectedly collected from Indian Creek but not from Stockade Beaver Creek, where they were previously sampled. A single brassy minnow was collected in Beaver Creek, and Barrineau et al. (2007) collected the first channel catfish and shorthead redhorse reported from the Cheyenne River Basin. Sand shiner, fathead minnow, and introduced green sunfish comprised 76% of all fish by number collected by Barrineau et al. (2007). Green sunfish (common), largemouth bass (uncommon), and yellow perch (rare) are non-native species present in the drainage.

Native fish species diversity is high throughout the basin, but introduced species provide virtually all of the sport fishing opportunity. Trout, largemouth and smallmouth bass, walleye, and tiger muskie are the most important game fish. The Lower Cheyenne River becomes intermittent in most years. Because the Cheyenne River and its major tributaries are intermittent most years, the drainage has been considered unsuitable for game fish, but the presence of green sunfish and black bullhead in Beaver Creek has been confirmed (BLM 2003c). These two species are abundant in the basin, but are regarded as nuisance species rather than important game species.

WGFD stocking records document the wide variety of salmonids and cool-water species stocked in standing waters since at least the 1930s. Most fishing in the basin occurs on ponds and reservoirs that are typically managed for trout, bass, or both. Standing waters primarily support local angling interests.

Stream intermittency is a historically expected basin condition (Druse et al. 1990), but increased frequency or duration of zero flow periods during drought or long-term climate change is likely to affect fish communities (Barrineau et al. 2007). Barrineau et al. (2007) details the most recent stream habitat conditions throughout the basin. Unsuitable habitat limits opportunities for salmonid fisheries. Illegally or intentionally introduced non-native fish pose predatory or competitive threats to native species throughout the Cheyenne River Basin (Barrineau et al. 2007).

Belle Fourche River Basin

The Belle Fourche River Basin covers over 3,762 square miles (WGFD 2008b). There is one fourth-level HUC from this basin in the planning area. Elevations in the basin range from 3,100 feet in the northeast corner of Crook County at the Wyoming-South Dakota state line to 6,645 feet at Warren Peak. The Upper Belle Fourche River sub-watershed is entirely within Campbell County in the western portion of the Belle Fourche River Basin.

Vegetation consists of mostly rolling grasslands and sagebrush, with the exception of ponderosa pine-dominated forestlands of the Black Hills National Forest. The principle land use of the drainage is livestock grazing and hay production. Water diversions for irrigation are common. Other land uses common to the drainage are oil and gas production, forest management, bentonite and coal mining, and recreation (predominately hunting, with the exception of fishing and water sports at Keyhole Reservoir) (WGFD 2008b).

The Belle Fourche River Basin is mostly comprised of private lands (82%), with only 18% being a mixture of state, BLM, National Forest, Thunder Basin National Grasslands, and state parks.

Thirty-six fish species have been documented in the Belle Fourche River Basin. Nineteen fish species have been introduced to the basin as sport fish or as forage to support the sport fisheries. Sixteen fish species are native to Wyoming, but the Snake River cutthroat is not native to the Belle Fourche River Basin (WGFD 2008b). Comparisons of data collected in the 1960s and the 1990s suggest that of the fish species present in the Belle Fourche River Basin, nine have declined over this 30-year period. The fine scale dace, flathead chub, fathead minnow, lake chub, mountain sucker, shorthead redhorse, plains minnow, river carpsucker, and stonecat have declined on spatial scales described by Patton as site, stream, sub-drainage, and drainage levels, compared with that of the 1960s sampling performed by Baxter and Simon (WGFD 2008b).

Most of the streams are unsuitable for cold-water fish and offer limited potential for warm-water game fish because of water diversion and lack of suitable habitat. Beaver ponds on some minimal-flow streams provide localized trout habitat, and many of the small streams in the Black Hills depend on beaver ponds to provide habitat for fish; however, flash floods or heavy sedimentation periodically eliminate these ponds for fisheries (WGFD 2008b).

Most of the potential for game fish exists in the numerous farm ponds and reservoirs, but many are subject to periodic winter or summer kills because of limited water availability. Many of the farm ponds and privately owned reservoirs contain stunted populations of bullhead or green sunfish. The largest lentic fishery in the drainage is Keyhole Reservoir (McDowell 1995).

Urban fisheries are very important in the Belle Fourche River Basin. Gillette Fishing Lake, Panther Pond, Medicine Lake, and Sundance Fairground Pond provide fisheries where little or no fishing opportunity would otherwise exist. Several thousand fish are stocked in the Belle Fourche River Basin every year. Catchable rainbow trout, Snake River cutthroat trout, and sub-catchable brook trout are used quite frequently on public waters such as Gillette Fishing Lake, Panther Pond, Spotted Tail Pond, and Sundance Fairgrounds Pond and on private waters that allow public access, such as Medicine Lake and Driskill Reservoir (when water is available). Warm- and cool-water species are stocked quite frequently as well, not only to provide anglers with more diverse fishing opportunities but also to help control undesirable species such as green sunfish and black bullheads (WGFD 2008b).

In general, suitable habitat for game fish is rare in the Belle Fourche River Basin. Due to the small size and low flow of the Belle Fourche River and its tributaries, sport fish potential is low. Most of the basin is very arid, as indicated by negative water balances ranging from 6 to 17 inches (Marston et al. 1990). Small reservoir impoundments are abundant in the Belle Fourche River Basin. With the exception of Keyhole Reservoir, game fish habitat is restricted to small impoundments and to a relatively few stream segments. Native fishes are limited by low-oxygen and high-temperature stress during periods of low flow (Barnes 1996).

High streamflow fluctuation, streamflow alteration, long periods of low flow, high turbidity, and siltation limit the potential of most streams and standing waters in the drainage to support game fish, particularly cold-water species. Fleischer (1978) noted that morphological modifications of the drainage from rechannelization, mining, and reclamation will alter surface water drainage patterns and flow regimes, a major consequence of which could be a reduction of inflow into Keyhole Reservoir (WGFD 2008b). Impacts of coal mining and CBNG industries on fisheries and wildlife in the Belle Fourche River Basin are not well understood. According to the Wyoming Oil and Gas Conservation Commission website, CBNG and natural gas development has increased in the Belle Fourche River Basin.

Little Missouri River Basin

The Little Missouri River Basin covers 735 square miles of northeastern Wyoming. There is one fourth-level HUC from this basin in the planning area. Most of the drainage is in Crook County, although small headwater sections originate in Campbell County. Elevations range from 3,460 feet near the Montana-Wyoming border to about 4,600 feet at the headwaters (Gumtow et al. 1994).

Vegetation throughout the drainage area consists of mostly sagebrush and grassland, with ponderosa pine along the ridges and breaks of the low rolling hills. Agricultural activities such as hay production and livestock grazing are predominant in the valleys and riparian areas.

Although there are some state and federal lands in the drainage, no public access is available to the flowing water, all of which is on private land (Mueller and Rockett 1966).

Twenty-four fish species have been documented in the Little Missouri River Basin; most are native nongame species. Seven species are not native to the Little Missouri River Basin. In general, suitable habitat for game fish is minimal in this drainage. Due to the small size and low flow of the Little Missouri River and its tributaries, sport-fish potential is low. Fish habitat in streams is mainly confined to large pools, which can be isolated during extreme low-water conditions. Game fish habitat is mostly restricted to small impoundments in the Little Missouri River drainage. Factors limiting standing waters in the Little Missouri River drainage include drought periods, drawdowns for irrigation, and stock watering. Shallow depths of standing waters often limit overwintering for fish, resulting in fish kills. Other factors affecting fisheries in the Little Missouri River drainage include a lack of data on fish population abundance and species distribution, and lack of public access to waters that do or possibly would support sport fisheries.

Game fish habitat is restricted to small reservoirs and stock ponds, limited streamflows in the Little Missouri River below its confluence with the North Fork Little Missouri River, and in the North Fork Little Missouri River (Mueller and Rockett 1964). Mueller and Rockett (1966) reported that the WGFD had stocked 33 reservoirs in the Little Missouri River drainage with game fish, and numerous other small reservoirs have populations of largemouth bass, green sunfish, and black bullhead introduced illegally. The WGFD stream/lake database lists 58 standing waters, 31 of which are listed as unsuitable for sustaining a fishery. The WGFD or private landowners who obtained stocking authorization have stocked many of these unsuitable waters and most of the remaining 27 waters noted as suitable. Often, these unsuitable waters, when they become suitable during good water years, are stocked again (by the landowner), and might support a fishery for a few years. At present, the WGFD does not stock any of the standing waters or streams in the drainage.

Fisheries management is currently very limited in the Little Missouri River Basin. With approximately 80% of the land in the basin being private, management opportunities are minimal. In recent years (2004 and 2005) native nongame fish in the basin have become a priority. Although fish abundance, distributions, life histories, and conservation needs are not well known, recent surveys provide insight that can aid future fisheries management in the Little Missouri River Basin.

All Basins

Continuing threats to fish populations in the planning area include sedimentation, high concentrations of salts and metals, fuel and drilling fluid runoff, degradation of riparian habitat (including vegetation removal, cottonwood depletion, invasive plant species, and impacts from livestock), changing water levels, and introductions of predatory fish, increased clarity, flow stabilization, and construction of stream and river crossings. Refer to the *Water* section of this document for total discharges of CBNG produced water contributing to each basin.

Management actions for fish generally address water sources and rights; habitat restoration, improvement, and conservation; impacts from other BLM resource program authorized activities; floodplain connectivity; land tenure adjustments; and recreation. The Buffalo Field Office has developed an activity plan, the *Buffalo Resource Area Wetland Habitat Management Plan* (HMP), to focus management of site-specific riparian-wetland habitat improvements in the planning area. This activity plan is in various stages of implementation.

Powder and Tongue Rivers

The assessment of potential effects of water produced from CBNG development on macroinvertebrate and algal communities in the Powder and Tongue Rivers indicates the following:

Invertebrate community metrics and O/E scores, as well as algal metrics, indicated a substantial decline in biological condition between sites downstream of Willow Creek and upstream of Pumpkin Creek. At other site pairs, multiple lines of evidence indicate no substantial differences or an increase in biological condition, such as an increase between sites upstream and downstream of Beaver Creek. The spatial variability indicates localized noncumulative stressors might be affecting the biota. Biological condition generally declined in the middle reaches of the Powder River, indicating potential cumulative effects form CBNG discharges in some reaches from Flying E Creek to downstream of Wild Horse Creek. The middle reaches of the Powder River also contained the highest alkalinity concentrations, a potential indicator of toxicity form sodium bicarbonate. Inflow of water between Barber Creek and Wild Horse Creek might be associated with the corresponding decline in macroinvertebrate community condition and increase in facultative nitrogen heterotrophic diatoms. The increase in nitrogen hetertrophs indicates that the water contains relatively high concentrations of organic nitrogen, Comparison of invertebrate metric results from 22010 to those from 2005–08 corroborated previous findings that biological condition in the middle reaches of the Powder was lower than in the upper or lower reaches (Peterson et al. 2011).

Biological condition in the lower reaches of the Powder River was variable. Biological condition on the Tongue Rover showed and increase in one case and a decrease in another. Few substantial differences were noted from upstream to downstream of Prairie Dog Creek. No notable differences were noted in the Tongue River upstream and downstream of Hanging Woman Creek (Peterson et al. 2011).

3.4.5.4. Trends

A relatively small percentage of waters in the planning area have available estimates of fish populations. These estimates show that there have not been any extensive declines in overall fish assemblages in recent years. However, fish populations in the planning area fluctuate due to naturally occurring events such as drought, fire, and floods, but anthropogenic effects from road crossings, flow alterations, and changes to water quality, can also influence populations. Standing-water habitat is limited by drought periods, drawdowns for irrigation, and stock watering. Shallow depths of these standing waters often limit overwintering for fish, periodically resulting in partial or complete winterkills. Fish habitat in many streams is mainly confined to pools that might be isolated during extreme low water conditions.

3.4.5.5. Key Features

Riparian areas represent a key feature in fisheries health. Four types of riparian ecosystems, including wetlands, have been identified in the planning area – forest dominated riparian, willow and shrub dominated riparian, herbaceous riparian, and wet meadow. Approximately three percent of the planning area is comprised of riparian and wetland areas.

Hunters, anglers, bird watchers, and biologists have long recognized the value of riparian ecosystems to fish and wildlife. Riparian ecosystems are particularly valuable in a dry environment such as Wyoming. It has been estimated that, although only a small percent of the planning area is classified as riparian land, about 80% of the native animals depend on riparian zones for food, water shelter, and migration routes during some time of the year (Olson and Gerhart 1982).

Alteration of hydraulic conditions can affect the physical and chemical properties in a wetland, such as pH, soil salinity, sediment properties, oxygen content, and nutrient availability. Small changes in hydraulic conditions can result in massive responses by wetland biota in terms of species composition, species richness, and ecosystem productivity. Changes to the interrelationships among surface-water dynamics, groundwater level, and river channel processes can lead to changes in the establishment and maintenance of dependent riparian plant communities (Busch and Smith 1995). These changes are rapidly occurring in the planning area. Impacts to the riparian ecosystems in the planning area are: livestock grazing, which increases channel erosion and agricultural water withdrawals; physical disturbances created by the extraction of oil and gas resources; water depletion from invasive species such as tamarisk and Russian olive; and discharge of CBNG produced water directly into riparian corridors.

Special management of these areas will be necessary to ensure riparian corridors are healthy, that these ecosystems remain intact, and that they can meet the needs of present and future demands on public lands. Riparian areas key to fishery habitat management occur in all delineated Areas of Relative Ecological Importance and in the remaining area not included in this designation.

3.4.6. Fish and Wildlife Resources – Wildlife

3.4.6.1. Regional Context

The planning area is in the southern portions of the short- and mixed-grass prairie ecoregion. Short- and mixed-grass prairie is the largest grassland ecoregion in North America, covering almost 247,000 square miles. This ecoregion covers parts of southeastern Alberta and southwestern Saskatchewan, much of the area east of the Rocky Mountains, central and eastern Montana, western North and South Dakota, and northeastern Wyoming. Four major features distinguish this unit from other grasslands – the harsh winter climate, with much of the precipitation falling as snow; short growing season; periodic severe droughts; and vegetation.

Two environmental gradients determine species composition in short- and mixed-grass prairies – increasing temperatures from north to south and increasing rainfall from west to east. With increasing latitude, the short-grass prairies take on an aspect more similar to mixed-grass prairies such as in this ecoregion, where many cool-season species predominate (Sims 1988). In general, this ecoregion has an arid grassland ecoclimate.

Please refer to the *Vegetation* sections for descriptions of habitats comprised of Forests and Woodlands, Grasslands and Shrublands, and/or Riparian/Wetland communities. The short- and mixed-grass prairie is surprisingly rich in mammals for an ecoregion so far north. Much of the bird fauna is comprised of species typically associated with the prairie potholes.

In pre-settlement times, drought, fire, and wildlife grazing were likely the major disturbance factors, with fire playing a smaller role than in other grassland ecoregions. The potential for large-scale restoration is perhaps greater in this ecoregion than in almost any other in North America.

Major degradation threats are exotic invasive species such as cheatgrass, leafy spurge, and tamarisk. There is increased industrial activity (particularly oil and gas), road expansion, and widespread application of pesticides and herbicides. Historic, current, and predicted activities in the planning area directly contribute to all of the threats to this ecoregion. The planning area is ecologically important to the continuity of the ecoregion as a whole.

BLM and WGFD guidance documents are available regarding BMPs and management of wildlife habitats (WGFD 2009c; BLM 2005a). Although not as specific in management focus as the HMPs and action plans identified below, the existing plan does guide BLM overall management of wildlife habitats in the planning area. Due to the relationship between wildlife habitats managed by the BLM and wildlife species managed by the WGFD, a statewide agreement was established to facilitate cooperation between these agencies related to wildlife (WGFD and BLM 1990). In accordance with the cooperative relationship between these agencies, the following description of wildlife species in the planning area is organized by WGFD statutory wildlife categories to facilitate the discussions. The primary headings are game species (big game, trophy game, small game, waterfowl and other water birds, upland game birds, and furbearers), non-game species (raptors, summer and year-round resident and migratory birds, and non-game mammals), predatory animals, and reptiles and amphibians.

Sagebrush ecosystems also support a variety of species. Sagebrush obligates are animals that cannot survive without sagebrush and its associated perennial grasses and forbs; that is, species requiring sagebrush for some part of their life-cycles. Sagebrush obligates in the planning area listed as sensitive species by BLM Wyoming include Greater Sage-Grouse, Brewer’s sparrow, sage thrasher, and sage sparrow; these species are further addressed in the *Special Status Species – Wildlife* section. Other sagebrush-obligate species in the planning area include sagebrush vole, pronghorn, and sagebrush lizard. Pronghorn are often associated with sagebrush, but also occupy grasslands in the planning area.

In addition, regional context for each species or species group are included where available/appropriate.

3.4.6.2. Indicators

Road density has been correlated with habitat effectiveness (BLM 2003c). The measurement of road density provides an approximation of the potential for impacts to wildlife in several ways. First, it allows for an estimate of the amount of wildlife habitat that might be adjacent to roads and, therefore, the amount of habitat that might be less effective because wildlife species sensitive to human disturbance avoid the habitat. Second, it provides a measure of the amount of habitat fragmentation, which is important in assessing impacts to wildlife species that require large tracts of habitat free from development. Third, it allows an estimate of other parameters important to wildlife populations, such as the potential for road-kill and the potential for disturbance and mortality related to hunting. The locations of many existing roads in the planning area, particularly associated with recent non-federal oil and gas development, are not known; therefore, neither a spatial analysis using buffers on existing roads nor a road density estimate are possible.

Fragmentation of shrub-steppe habitat is a major disruption that has consequences for sagebrush-obligate species (Braun et al. 1977; Rotenberry and Wiens 1978). In fragmented habitats, suitable habitat area remains only as remnants surrounded by unusable environments (Urban and Shugart 1986; Fahrig and Paloheimo 1988). Populations of sagebrush-obligate species decline because areas of suitable habitat decrease (Temple and Cary 1988), because of lower reproduction, and because of higher mortality in remaining habitats (Robinson 1992; Porneluzi et al. 1993).

The extent of indirect impacts to wildlife species from human uses adjacent to their habitats varies by species and other factors such as topography, vegetative screening, habituation to disturbance, and frequency and intensity of disturbance. Mule deer, for example, tend to reduce their habitat use within 0.125 mile of roads (Rost and Bailey 1979). Elk tend to reduce their use of habitats within 0.5 mile of roads (Ward 1976). By applying a buffer to existing roads, it is possible to estimate the amount of habitat that has been reduced in effectiveness for a species.

Please refer to the *Vegetation* sections for descriptions of indicators of vegetation health for habitats comprised of Forests and Woodlands, Grasslands and Shrublands, and/or Riparian/Wetland communities. In addition, indicators for each species or species group are included where available/appropriate.

3.4.6.3. Current Condition

All of the vegetative types listed in the *Vegetation* sections provide habitat for some wildlife species. In an undisturbed condition, the major vegetative types in the planning area provide high-quality habitats for many wildlife species. Because these habitats tend to occur in a mosaic across the landscape, many wildlife species use more than one habitat. Most of the habitat consists of mixed-grass prairie, sagebrush shrubland, other shrubland, and riparian areas (including herbaceous, willow and shrub dominated, and forest dominated riparian areas). In addition to the common vegetative types, wet meadows tend to provide habitat for wildlife species associated with nearby dominant vegetation cover types, such as prairie or sagebrush shrubland, although in areas of large wet-meadow complexes, species common to riparian habitats can also occur. Furthermore, although they occur only sporadically throughout the planning area, coniferous woodlands support a different set of wildlife species than the main habitat types, primarily as a result of seed production and potential nest substrates provided by the various conifer species.

The terrestrial vertebrate wildlife species in the planning area represent all major vertebrate classes – reptiles, amphibians, birds, and mammals. The following paragraphs list some of the wildlife species present in the common vegetative types in the planning area, although these species can also be present in other habitat types if the necessary habitat components are available. The *Special Status Species* sections that follow this discussion of wildlife address species of special concern (Threatened, Endangered, and BLM sensitive species).

Common wildlife species that typically occur in mixed-grass prairie habitats include prairie rattlesnake, golden eagle, prairie falcon, ferruginous hawk, Swainson's hawk, plains sharp-tailed grouse, lark bunting, horned lark, western meadowlark, lark sparrow, vesper sparrow, chestnut collared longspur, McCown's longspur, badger, coyote, swift fox, thirteen-lined ground squirrel, black-tailed jackrabbit, Ord's kangaroo rat, deer mouse, western harvest mouse, plains pocket gopher, black-tailed prairie dog, mule deer, and pronghorn.

Common wildlife species that may occur in sagebrush shrublands include eastern short-horned lizard, prairie rattlesnake, northern harrier, Swainson's hawk, Greater Sage-Grouse, Say's phoebe, western kingbird, horned lark, sage thrasher, Brewer's sparrow, vesper sparrow, sage sparrow, western meadowlark, desert cottontail, black-tailed jackrabbit, thirteen-lined ground squirrel, northern pocket gopher, Ord's kangaroo rat, deer mouse, prairie vole, pronghorn, and mule deer.

Common wildlife species that can occur in other shrublands are similar to those that inhabit sagebrush shrublands, and include garter snake, chukar, plains sharp-tailed grouse, western kingbird, horned lark, black-billed magpie, rock wren, sage thrasher, lazuli bunting, spotted towhee, Brewer's sparrow, lark sparrow, lark bunting, bobolink, masked shrew, desert cottontail, least chipmunk, Wyoming ground squirrel, thirteen-lined ground squirrel, deer mouse, northern grasshopper mouse, coyote, western spotted skunk, pronghorn, and mule deer.

Wildlife species that can occur in riparian areas (including herbaceous, willow and shrub dominated, and forest dominated riparian areas) include bull snake, tiger salamander, northern leopard frog, northern harrier, Virginia rail, sora, common snipe, short-eared owl, marsh wren, common yellowthroat, savannah sparrow, song sparrow, red-winged blackbird, yellow-headed blackbird, deer mouse, meadow vole, red fox, pronghorn, mule deer, and white-tailed deer. Wet meadows tend to provide habitats for wildlife species associated with nearby dominant vegetation cover types (such as prairie or sagebrush shrublands), although in areas of large wet-meadow complexes, species common to riparian habitats can also be present.

Common wildlife species in coniferous forest include mountain chickadee, mourning dove, golden eagle, mountain bluebird, northern flicker, western tanager, pinyon jay, chipping sparrow, lark sparrow, Nuttall's cottontail, mule deer, gray fox, black-tailed jackrabbit, porcupine, bushy-tailed woodrat, and mountain lion.

Prairie dog colonies are of particular importance to the planning area because these unique ecosystems create habitat for many species of wildlife (King 1955; Reading et al. 1989). Agnew et al. (1986) found that bird species diversity and rodent abundance were higher on prairie dog towns than on mixed-grass prairie sites. Several studies (Agnew et al. 1986; Clark et al. 1982; Campbell and Clark 1981; Reading et al. 1989) suggest that species richness increases with colony size and regional colony density. Prairie dog colonies attract many insectivorous and carnivorous birds and mammals because of the concentration of prey species (Clark et al. 1982; Agnew et al. 1986; Agnew et al. 1988). In South Dakota, 40% of the wildlife taxa (134 vertebrate species) are associated with prairie dog colonies (Agnew 1983; Agnew et al. 1986; Apa 1985; McCracken et al. 1985; Uresk and Sharps 1986; Deisch et al. 1989). Of those species regularly associated with prairie dog colonies, six are on the BLM Wyoming sensitive species list – swift fox, mountain plover, ferruginous hawk, burrowing owl, loggerhead shrike, and long-billed curlew.

Three HMPs currently guide management in the planning area: the South Bighorns HMP (BLM 1986b); the Buffalo Resource Area; Wetland HMP (BLM 1986c); and the Middle Fork Powder River HMP (BLM 1980). Although they remain relevant, all of these plans need to be revised.

Current conditions for each species or species group are included where available/appropriate.

Big Game

Current Condition

Big game species expected to occur in suitable habitats throughout the planning area include pronghorn, white-tailed deer, mule deer, elk, and moose. The WGFD has identified various ranges for big game species, as follows:

- *Crucial Range* is any particular seasonal range or habitat component, but describes the component documented as the determining factor in a population's ability to maintain and reproduce itself at a certain level (see Map 23).
- *Summer or Spring-Summer-Fall* use is when a population or portion of a population of animals uses the documented habitats in this range annually from the end of previous winter to the onset of persistent winter conditions.
- *Severe Winter Relief* is a documented survival range that might or might not be considered a crucial range area as defined by crucial range. It is used, to a great extent, only in extremely severe winters. It might lack habitat characteristics that would make it attractive or capable of supporting major portions of the population during normal years, but is used by and allows at least a substantial portion of the population to survive the occasional extremely severe winter.

- *Winter* use is when a population or portion of a population of animals uses the documented suitable habitat sites in this range annually and in substantial numbers only during the winter period.
- *Winter-Yearlong* use is when a population or a portion of a population of animals makes general use of the documented suitable habitat sites in this range year round. During the winter months, there is a considerable influx of additional animals into the area from other seasonal ranges.
- *Yearlong* use is when a population of animals makes general use of suitable documented habitat sites in the range year round. Animals might leave the area under severe conditions.
- *Calving Areas* are documented birthing areas commonly used by females. It includes calving areas and fawning areas. These areas might be used as nurseries by some big game species.

Other than the specific ranges identified by the WGFD for each species, Map 23 shows baseline data on other aspects of each species' seasonal activities and movements (for example, fawning areas and priority migration corridors).

The planning area encompasses all or part of 26 big game populations or herd units (12 pronghorn, 5 mule deer, 4 white-tailed deer, 6 elk, and 1 moose).

Indicators

Established population size "objectives" guide management strategies for each big game herd unit. The WGFD establishes these objectives through a public and interagency review and input process and sets population size objectives at a biologically sustainable and socially acceptable level. The WGFD considers weather trends, performs habitat condition assessments, compiles population information (line transect surveys, classification surveys, and population modelling) and collects and analyzes hunter statistics and harvest information in order to assess population size and distribution of big game. Moderate to extreme fluctuations in this data typically warrants changes in hunting seasons or harvest to stabilize populations at desired objectives. For current population objectives, current population estimates, population trends, and management challenges for each herd unit, see the most recent WGFD Sheridan Region Job Completion Report.

Pronghorn

Regional Context

Pronghorn are unique to the western plains of North America and are the only living species in their taxonomic family (Antilocapridae). Wyoming is the center of the pronghorn's range and supports the largest population of pronghorn (Clark and Stromberg 1987). Pronghorn typically inhabit grasslands and semi-desert shrublands of the western and southwestern United States. This species is most abundant in short- and mixed-grass habitats and is less abundant in more xeric habitats. Home ranges for pronghorn can vary between 400 acres and 5,600 acres, according to several factors including season, habitat quality, population characteristics, and local livestock occurrence. Typically, daily movement does not exceed 6 miles. Some pronghorn make seasonal migrations between summer and winter habitats, but these migrations are often triggered by availability of succulent plants and not local weather conditions (Fitzgerald et al. 1994).

Current Condition

Pronghorn occur in most of the planning area, except in the foothills in the western margin of the central portion of the area. The WGFD has divided pronghorn into herd units to estimate population sizes. The following pronghorn herd units reside entirely or partially in the planning area: 203, 308, 309, 310, 316, 318, 339, 351, 352, 353, 354, 355, 740, and 748. The WGFD has estimated that the population size of all herd units in the planning area is 217,330 animals (WGFD 2007a). The overall population objective of this same group of herd units is 143,500 animals; therefore, population levels are currently at 151% of the objective.

Potential management concerns common to most herd units include obtaining adequate classification samples, inconsistent line transect density estimates, limited hunter access to private lands, high buck ratio, difficulty attaining desired harvest, limited or inaccessible public-land hunting opportunities, expanding subdivisions limit hunting opportunity and hunter access, and urban development (WGFD 2007a).

Extensive ongoing and planned future CBNG development is also noted as a potential management concern for a number of herd units. The increase in CBNG activity has resulted in restricted surface access on the large tracts of public land. This results in frustration from hunters seeking a public-land hunt, and has upset some non-resident hunters who had returned to the area annually and are not able to access areas they once frequented as landowners become concerned about the safety of hunters and CBNG employees on their property. CBNG development has also been an issue with hunter satisfaction; complaints have increased regarding the quality of the hunting experience while dealing with increasing CBNG traffic and land use. A new coal mine is proposed for the Ash Creek area that could open as soon as 2011. This general area contains a small population of pronghorn.

Trends

The overall population trend for pronghorn in the planning area is stable to increasing.

Deer

Current Conditions

Both mule deer and white-tailed deer occur in the planning area. Mule deer are distributed throughout the seasonal ranges, and generally prefer habitat types in the early stages of plant succession and 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. They are often present in juniper and limber pine woodlands, sagebrush/rabbitbrush, bitterbrush/sagebrush steppe, and riparian habitat types. White-tailed deer use woody riparian habitats along creeks and rivers for forage and cover.

Mule Deer

Regional Context

Mule deer occur form southern Yukon and northwest territories of Canada, south through the western United States to Wisconsin and western Texas. Mule deer in Wyoming are among the eastern edges of this species' distribution. In Wyoming, mule deer occur in mountains and associated foothills, broken hill country, and prairie grasslands and shrublands (Clark and Stromberg 1987).

Current Conditions

Browse is an important component of the mule deer's diet throughout the year, making up as much as 60% of total intake during autumn, while forbs and grasses typically make up the rest of their diet (Fitzgerald et al. 1994). This species tends to be more migratory than white-tailed deer, traveling from higher elevations in summer to winter ranges that provide more food and cover. Fawn mortality is typically due to predation or starvation. Adult mortality often occurs from hunting, winter starvation, and collisions with automobiles. Typical predators can include coyotes, bobcats, golden eagles, mountain lions, bears, wolves and domestic dogs (Fitzgerald et al. 1994).

Mule deer ranges occur in almost all parts of the planning area. The WGFD has divided mule deer into herd units to estimate populations. Seasonal range maps are subject to change as new management data becomes available. The following herd units reside entirely or partially in the planning area: 208, 319, 320, 321, 322, 751, 752, and 755.

Extensive ongoing and planned future CBNG development is noted as a potential management concern for a number of herd units. CBNG development in some areas is creating problems for hunters. Public accessibility to BLM and state lands is particularly problematic, because intensive development activity has reduced hunting opportunity and quality. In recent years, these lands have attracted fewer hunters. Almost all landowners charge access fees or require an outfitter for buck hunting, and tend to cater to non-resident hunters. Increases in land use by the CBNG industry create additional restrictions as landowners become concerned about safety issues and restrict hunting where CBNG activity is high. Increased traffic and other activities associated with the CBNG industry also interfere with an "enjoyable hunt," and this issue has become a more frequent complaint on landowner surveys for the region. When these factors cause landowners to more tightly control access to private lands, it increases pressure on the few areas of public land available in this herd unit. Many hunters contacted on public land (mainly Thunder Basin National Grassland) complained of the low quality and young age of bucks and the excess of does, which can mainly be attributed to increased hunting pressure on public lands (WGFD 2006b; WGFD 2007a).

Trends

The WGFD has estimated that the population of all herd units in the planning area is 157,125 animals (WGFD 2007a). The overall population objective of this same group of herd units is 154,000 animals. Three individual herd units, Southwest Bighorns (208), Pumpkin Buttes (320), and Upper Powder River (322) are not at objective, but the remaining herd unit populations have exceeded their objectives with levels ranging to 144%.

The Pumpkin Buttes herd unit population has been relatively stable over the last few years due to lower fawn ratios. The 2007 fawn ratio was 60:100, slightly below the 5-year average of 66:100. The Upper Powder River herd unit has been relatively stable since 2001 when a population decline occurred due to winter mortality and low productivity and recruitment. In the remaining herd units, lack of hunter access to private land, increased activity related to the CBNG industry, and attempts to balance private and public land use have resulted in herd numbers that exceed population objectives (WGFD 2007a; WGFD 2006b). Specific to the North Big Horn (321) mule deer herd unit, migration of deer between hunt areas and nonresident deer regions; movement of deer across the Montana State line onto the Crow Indian Reservation, where harvest is unregulated; and hunter/harvest distribution associated with private versus public lands has contributed to management challenges.

White-tailed Deer

Regional Context

White-tailed deer occur throughout North America from the southern United States to Hudson Bay in Canada. Across much of its range, this species inhabits forests, swamps, brushy areas, and nearby open fields. White-tailed deer are present throughout Wyoming, typically concentrated in riparian woodlands, shrubby riparian and associated irrigated agricultural lands, and are generally absent from dry grasslands and coniferous forests (Clark and Stromberg 1987).

Current Conditions

Their diet is diverse, capitalizing on the most nutritious plant matter available at any time. In addition to native browse, grass, and forbs, this species relies on agricultural crops, fruits, and acorns and other nuts. White-tailed deer mortality is typically related to hunting, winter starvation, collisions with automobiles, and predation. Predators can include coyotes, mountain lions, wolves, and occasionally, bears, bobcats, and eagles (Fitzgerald et al. 1994).

In the planning area, white-tailed deer are restricted to river and stream drainages across the Powder River Basin and to riparian habitats associated with the northern foothills of the Big Horn Mountains. They tend to be absent from large expanses of prairie and shrubland.

The WGFD has divided white-tailed deer into herd units to estimate population sizes. Seasonal range maps are subject to change as new management data becomes available. The following herd units reside entirely or partially in the planning area: 201, 303, 706, and 707.

Trends

The WGFD has estimated the population size of two of these herd units (13,757 in herd unit 303, with a objective of 8,000, and 44,125 in herd unit 706, with a objective of 40,000); however, survey data were not adequate to allow estimates of the sizes of the other herd unit. The population is thought to be substantially higher than the objectives for both herd units, with a stable or increasing trend (BLM 2003c). The stated cause for populations substantially higher than objective is lack of public access for hunting, and urbanization in the northwest part of the planning area.

Elk

Regional Context

Elk formerly ranged over much of central and western North America from the southern Canadian Provinces and Alaska south to the southern United States, and eastward into the deciduous forests. This species is present throughout Wyoming in a variety of habitats, including coniferous forests, mountain meadows, short- and mixed-grass prairies, and sagebrush and other shrublands.

Current Conditions

In the planning area, elk are concentrated in the Big Horn Mountains and associated foothills, the Fortification Creek area west of Gillette, the Pine Ridge area in the south, and the Rochelle Hills in the southeast. Similar to other members of the deer family, this species relies on a combination of browse, grasses, and forbs, depending on their availability throughout the seasons. Elk tend to be migratory, moving between summer and winter ranges, although within the planning area, the Fortification Creek and Rochelle Hills elk herds are essentially non-migratory. Specific studies on seasonal movement and range use have been completed for the Fortification Creek herd unit;

therefore, data for this area are presented separately from the other herd units. Typically, mortality is a result of predation on calves, hunting, and winter starvation. Predators can include coyotes, mountain lions, bobcats, bears, wolves, and golden eagles.

The WGFD has divided elk into herd units to estimate population sizes. The following herd units reside entirely or partially in the planning area: 211, 320, 321, 322, 344, and 743. The WGFD has estimated the total population size of five of these herd units at 14,165; however, survey data were not adequate to allow a population estimate of the size of herd unit 743. For this herd unit, the population is thought to be substantially higher than the objective of 125 animals (BLM 2003c). The overall population objective of the same group of four herd units is 10,550 animals; therefore, population levels are currently at 134% of objective. All herd units are within the planning area have greatly exceeded their objectives, with population levels ranging from 116 to 270% of objectives (WGFD 2009a). The stated cause for these populations that are substantially higher than the objective is lack of public access for hunting and unwillingness on the part of some landowners to allow access to private lands for hunting at a level sufficient to allow effective herd management.

Extensive ongoing and planned future CBNG development was noted as a potential management concern for one herd unit. Impacts from CBNG development are not known at this time; however, increased road density, produced-water discharge, loss of vegetation, and increased human presence have the potential to adversely affect herd units subject to substantial CBNG development (BLM 2003c).

Trends

The overall recent trend has been decreasing herd numbers; however, this decrease has been in response to management actions (increased hunting opportunities) designed to reduce populations (BLM 2003c). Two herd units, 321 and 344, have experienced slight increases due to limited harvest in 321 and conservative hunting management in 344.

Moose

Regional Context

In North America, moose occur from Alaska to the northeastern United States and south along the Rocky Mountains into Colorado. Typical moose habitats in the Rocky Mountains include willow, spruce, fir, aspen, or birch. These habitats are common to forest dominated riparian, shrub dominated riparian and wet meadow vegetative types.

Current Conditions

Moose ranges are extremely limited in the planning area and are restricted to areas along the western boundary in the Big Horn Mountains. These range data are based on seasonal range maps available from the WGFD at the time of this writing. Seasonal range maps are subject to change as new management data become available. Willow is an important dietary component on all seasonal ranges, especially in winter range when grasses, forbs, and aquatic vegetation are less available. Moose tend to have strong affinity for specific home ranges, but would make seasonal migrations in search of suitable forage and habitat. Major mortality factors include hunting, starvation, and predation. Common predators include mountain lion, wolverine, coyote, bear, lynx, wolves, and domestic dog (Fitzgerald et al. 1994).

There are existing disturbances to moose habitats attributed to agriculture, oil and gas well pads, or urban areas the planning area. Specific data on mining, roads, compressors, and ancillary oil and gas facilities are not available in sufficient detail to allow a determination of their impacts on moose habitats.

The 313 herd unit is the only moose herd unit in the planning area. WGFD has estimated that the population of this herd unit is 476 animals (WGFD 2007a). The overall population objective of this herd unit is 500; therefore, population levels are currently at 95% of objective. Some problems associated with the management of this herd include lack of sufficient funding for data collection, lack of a reliable population estimate technique, non-hunting mortality (e.g., illegal harvest and moose-vehicle collisions), and possible forage competition with elk and livestock. Moose have been reduced in historic, highly visible areas with easy access. Survey of “back country” moose has proven difficult and the resulting data are inconsistent, making analysis difficult at best (WGFD 2007a).

Trends

The overall population trend for moose in the planning area has been decreasing.

Trophy Game

The WGFD classifies mountain lions and black bears as trophy game.

Mountain Lion

Regional Context

Formerly distributed throughout North America, the mountain lion is now found mostly in remote areas of the western United States. Mountain lions are typically present in remote areas with dense cover and rocky, rugged terrain. They are present in most habitats where deer, their primary prey base, are present.

Indicators

Local and regional management objectives are developed and evaluated based on WGFD-collected harvest data. A source-stable-sink adaptive management approach is applied evaluating (1) density of human caused mortalities, (2) sex-age composition of mountain lion harvest focusing on relative proportion of adult female harvest, and (3) the relative age of harvested adult females. WGFD will implement adaptive management strategies to address short and long-term management needs where appropriate and additional research efforts will be conducted to address other management priorities as funds become available relative to other Department needs. Mountain lion management objectives are based on ecological data and social conditions to ensure management strategies benefit both the species of concern and the people who are impacted by mountain lion conflicts (WGFD 2006a).

Current Conditions.

From Hunt Year 2003 through March 31, 2009, 46 mountain lion mortalities were attributed to incidental snaring and trapping. Next to legal harvest, this represents the highest source of human-caused mountain lion mortality in Wyoming. Because mountain lions are curious and strong, they appear susceptible to neck snaring.

Human safety and human/mountain lion interactions are topics vigilantly addressed and monitored where people and mountain lions coexist. Annual educational efforts continue, and if warranted, will be increased to inform the public about mountain lion behavior and safety procedures to follow when humans come in contact with mountain lions. There are preventive methods (i.e., landscaping, husbandry techniques, and outdoor awareness) that reduce the overall chance of human/mountain lion encounters. Education increases the ability of humans and mountain lions to cohabit.

Livestock (primarily sheep) depredation attributed to mountain lions will always be an issue of contention to be addressed regarding mountain lion management in Wyoming. Certain hunt areas are being managed as sinks because of depredation issues.

Trends

The current WGFD mountain lion management plan is still relatively new; therefore, assessment of the adaptive techniques involved is critical to evaluate the overall effectiveness of the plan.

Black Bear

Regional Context

Black bears are found in most of Alaska, southeastward through Canada to northern Minnesota, Wisconsin and Michigan and in the Maritimes, south through New England, New York, Pennsylvania and the Appalachian Mountains to Florida. They are also found on the west coast in northern California, east through the Rocky Mountain states to New Mexico as well as in Arkansas and Oklahoma.

Indicators

WGFD employs a range of harvest criteria to assess harvest impacts on black bears in Wyoming. These include percent adult males in the harvest, percent of females in the harvest and percent of adults in the female segment of the harvest. All data is analyzed using 3-year averages, compiled over 10-year periods for long-term trends. In addition to harvest data, WGFD monitors annual average human-caused black bear mortality per area of suitable habitat for each hunt area. This density provides an index of more localized impacts of human-caused mortality on black bear populations. With future population density estimates, this metric is also used to gauge the proportion of black bear population harvested annually.

Current Conditions

Black bears are present along the western boundary of the planning area in the Big Horn Mountains. Black bears prefer forested and shrubby areas. They are also known to inhabit ridgetops, burned areas, riparian areas, agricultural fields, and avalanche chutes. Black bears can be present in dry sage and juniper habitats. In mountainous areas, they seek southerly slopes at lower elevations for forage and move to northerly and easterly slopes at higher elevations as summer progresses. Black bears use dense cover for hiding and thermal protection, and for bedding. They climb trees to escape danger and use forested areas and rivers as travel corridors.

Annual harvest totals for the Bighorns BMU show a relatively steady rate of harvest since 1979, with a decline shortly after female quotas began in 1994. Harvest criteria indicate that harvest is beginning to affect the black bear in this BMU. The percent of adult males in the harvest decreased in the late 1990s and then increased into the population reduction range. The percent of females in the total harvest has remained in the stable range since the mid 1990s and the percent of adults in the female harvest moved from stable to increasing (WGFD 2007a).

Healthy stands of timber, especially lodgepole pine and spruce-fir in different stages of succession, are essential to provide suitable habitats for black bears. These habitat types provide forage, cover, and bedding areas. Adverse impacts to important bear habitats can be more detrimental to bear populations than human-induced mortalities, particularly if the impacts are irreversible. Because of the difficulty in observing black bears, estimating their abundance is an ongoing management challenge. The overall goal of black bear management in Wyoming is to sustain black bear populations throughout all suitable habitats while maintaining recreation opportunities and managing black bear damage (WGFD 2007b).

Trends

Populations for black bear are thought to be stable or increasing in the planning area.

Small Game/Game Birds

Small game includes small game mammals and upland game birds. Most of the data on these species come from harvest statistics kept by the WGFD for management areas in the state.

Mammals

Regional Context

The small-game mammals are cottontails, snowshoe hares, and red, gray, and fox squirrels. Cottontails, mountain of Nutall's can typically be found from extreme south-central British Columbia and western Washington, south to eastern California, and east through Saskatchewan, Montana and south into northern New Mexico. Snowshoe hare distribution is throughout Alaska and most of Canada south to northern California, northern New Mexico, northern Minnesota, northern Michigan, northern New Jersey and southward through the Allegheny Mountains. Red squirrels occur throughout much of Alaska and Canada. In the United States, they occur through the Rocky Mountain states and to the east to Iowa, northern Illinois, northern Indiana, Northern Ohio, northern Virginia and through the Alleghenies. Both the fox and gray squirrels are at the western-most edges of their range in Wyoming as they typically occur in the eastern United States from New England, westward to the Dakotas and eastern Texas.

Indicators

The majority of Wyoming's mammalian SGCN are not truly monitored (WGFD 2010).

Current Conditions

These species are present throughout the planning area and are hunted during fall and late winter. Due to the wide distribution of small-game species throughout Wyoming, no management challenges have been identified in the planning area. The primary BLM management effort is directed toward maintaining the continuity of ecosystems in the planning area.

Trends

Small-game population trends in the planning area are unknown, although these populations appear to be relatively stable over time. Small-game populations likely fluctuate as a result of naturally occurring phenomena such as drought, fire, and floods.

Upland Game Birds

Upland game birds in the planning area include chukars, Hungarian partridge, ring-necked pheasant, wild turkey, Greater Sage-Grouse, and sharp-tailed grouse (Orabona et al. 2012). Greater Sage-Grouse, although listed as an upland game bird by WGFD, is a BLM Wyoming sensitive species and is addressed in detail in the *Special Status Species – Wildlife* section of this chapter.

Regional Context

Chukars are present in hilly and rolling terrain along mountain foothills, and to some extent in badland topography. This species ranges throughout the northwest and southwest form California and Western Canada eastward through the Plains and the Rocky Mountains. The Hungarian partridge prefers habitat of open, grassy areas in a cool, dry climate. Preferred nesting areas include grasslands, hay and grain fields, and especially alfalfa fields. Heavily wooded areas are almost always avoided. This species occupies a range along the northern United States and southern Canada, westward through the Plains and the Rocky Mountains to the northwest. Ring-necked pheasant habitat includes farmlands, pastures, and grassy woodland edges. These habitats are occupied by the ring-necked pheasant throughout the majority of the northern United States and southwestern Canada and scattered throughout portions of the southwest United States. Wild turkeys are present in wooded areas in the upper elevations and along riparian corridors. This species occurs throughout a large portion of the United States, from Florida to the Great Lakes, Texas to southwestern Canada, and from the Mid Atlantic to the Rocky Mountains and scattered populations in California and the northwest. The sharp-tailed grouse is present throughout much of central Canada and from Montana to central Nebraska. This species inhabits short- and mixed-grass prairie, sagebrush shrublands, woodland edges, and river canyons (Sibley 2003).

Indicators

Birds are the most monitored taxa in Wyoming. Key efforts include annual breeding bird surveys and strategies outlined in the Wyoming Bird Conservation Plan. Additionally, the WGFD is involved in a variety of single species monitoring efforts related to raptors, waterfowl, and a few upland birds. Program adaptation occurs when new information or changing conditions trigger modification of individual actions to accomplish conservation goals or evaluation and adaptation of Wyoming CWCS (WGFD 2005).

Current Condition

Chukars, Hungarian partridges, ring-necked pheasants, and wild turkeys are present in their preferred habitats throughout the planning area. These populations do periodically fluctuate as a result of naturally occurring phenomena such as drought, fire, and floods. The BLM does not specifically monitor or manage any of these species other than through normal hunting seasons.

In Wyoming, and throughout the planning area, sharp-tailed grouse are present where grasslands are intermixed with shrublands, especially wooded draws, shrubby riparian areas, and wet meadows. Species of shrubs that produce berries (such as chokecherry) provide important winter forage for sharp-tailed grouse. Each spring, the males perform elaborate mating dances on historical strutting and dancing grounds called leks (BLM 2003c). Leks are typically on hilltops, ridges, or other high points in low, open grassland habitats. Data provided by the WGFD, Nongame Division, indicate that plains sharp-tailed grouse leks are present primarily in the northern portion of the planning area, where sharp-tailed grouse preferred habitats are most common. There are 102 documented lek sites in the planning area. Past surveys have not covered the entire planning area because of the amount of private land present; therefore, the number of leks could be higher.

Management actions for game birds generally are directed at activities around delineated breeding and nesting habitats (e.g., sharp-tailed grouse leks). Wild-turkey populations are thriving; therefore, there are no opportunities for wild-turkey introductions in cooperation with the WGFD. There are opportunities for translocation of nuisance wild turkeys in the planning area, although no areas for placement of these turkeys have been identified. Current management restricts or prohibits surface occupancy within 250 yards of a sharp-tailed grouse leks and does not allow surface use within 0.64 mile of leks between April 1 and May 7. The BLM authorized officer may grant exceptions to both restrictions. Management challenges focus on maintaining or enhancing the presence of game birds and the habitats upon which they depend.

Trends

Populations of chukars, Hungarian partridges, ring-necked pheasants, and wild turkeys appear to be relatively stable.

Sharp-tailed grouse population trends are not known at this time; however, populations are thought to be declining due to habitat removal and fragmentation by oil and gas development and urbanization throughout the planning area.

Migratory Game Birds

Regional Context

The planning area is in the central flyway (east of the Continental Divide). The planning area includes part of the Northern Great Plains joint venture area. Appendix K (p. 1749) lists species of concern to the Northern Great Plains joint venture. Ducks Unlimited has developed a national conservation plan (Ducks Unlimited 2004) that addresses waterfowl management needs, including those in Wyoming.

Indicators

In cooperation with the USFWS, the Migratory Game Bird Section of the WGFD conducts the following annual surveys to derive population indices for management: September crane survey, mid-winter waterfowl survey, Canada goose breeding population survey, Rocky Mountain population of Canada geese molt survey and mourning dove call-count survey. The Migratory Game Bird Section remains strongly involved in the Central and Pacific Flyway management efforts, including development and revision of management plan for various migratory game bird populations and annual season setting (WGFD 2010).

Current Conditions

Ducks and geese are present in aquatic areas throughout the planning area. Some individuals or species breed, winter, or remain in the state year round, while larger numbers pass through during spring or fall migration. The various sources of water, natural lakes, streams, and man-made reservoirs are important resting areas for a variety of waterfowl species, including ducks, geese, snipe, rails, and shorebirds. Aquatic resources scattered throughout the planning area support various species of waterfowl during nesting periods, and private agricultural lands provide important foraging habitat where grains and hay are grown. 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.

Waterfowl species that can be present in the planning area include Canada goose, wood duck, mallard, gadwall, harlequin duck, green-winged teal, American widgeon, northern pintail, northern shoveler, blue-winged teal, cinnamon teal, Barrow's goldeneye, bufflehead, canvasback, lesser scaup, tundra swan, and redhead. The occurrence and distribution of these species vary and are influenced by local conditions such as aquatic habitat, adjacent upland habitat, season, and land use practices. These waterfowl species are expected to be present in suitable habitats in the planning area during the appropriate species-specific nesting, migration, and wintering seasons.

Historic activities in watersheds that have contributed to loss or degradation of habitat in the planning area include recreation, agriculture, forest management, fire management, urbanization, and land development. Management of wetlands and riparian areas in this arid climate continues to be a challenge. Other challenges include access to public lands during breeding season, contaminants, invasive plant species, and water quantity and quality. The BLM will continue to seek opportunities to develop and enhance migratory bird habitats in the planning area.

Various methods of handling produced water could have caused impacts. At present, much of the CBNG produced water is discharged to surface drainages. Important wildlife habitat may be severely impacted or eliminated by surface discharge of produced water. Impoundment of streams receiving produced water tends to increase waterborne selenium concentrations through evaporative concentration and create a hazard for migratory aquatic birds. Fish also can bioaccumulate selenium directly from the water as well as from their diet. Top level consumers in aquatic systems, such as waterfowl, can readily accumulate selenium concentrations leading to low reproduction, embryonic deformities and increased mortality.

In an Assessment of Contaminants Associated with Coal Bed Methane-Produced Water and Its Suitability for Wetland Creation or Enhancement Projects (USFWS 2005), aquatic vegetation was collected from all sites where it was present. Boron concentrations in aquatic vegetation collected from these sites, where it was present, exceeded the 30 µg/g level documented to effect growth in ducklings. Cadmium concentrations in aquatic vegetation from two sites and one site's levels were slightly above the 0.1 µg/g wet weight level that should be "viewed with caution" in terms of wildlife dietary levels. Chromium concentrations in pondweed from two sites exceeded the wildlife dietary threshold of 10 µg/g. Selenium concentrations in water, sediment, and biota were below threshold levels known to cause adverse effects to sensitive species of fish and aquatic birds, with the exception of CBM produced water discharges and CBM closed containment impoundments. Closed containment ponds containing high selenium water may present a risk to aquatic birds using these ponds if the ponds provide a dietary route of exposure through submerged aquatic vegetation or aquatic invertebrates (USFWS 2005). In addition, toxic concentrations of salts could be accumulating in some containment reservoirs, making them unsuitable for waterfowl use.

Trends

No estimates of population sizes in the planning area are available for any of these species. Mourning doves are abundant in a variety of habitats in the planning area. Call-counts declined considerably throughout the Central Management Unit over the most recent 10-year and the 43-year periods. However, no obvious trends were noted.

Furbearing Animals

Badger, beaver, bobcat, American marten, mink, muskrat, and weasel are furbearing animals present in the planning area.

Regional Context

Distribution of the badger in North America includes the open plains and prairies, farmland, and sometimes edges of woods in the western United States, east to eastern Texas, Oklahoma, northern Missouri, northern Illinois, northern Indiana, and northern Ohio, north to southeastern British Columbia, Alberta, Manitoba, and Saskatchewan. The beaver occupies most of Canada and the United States except for most of Florida, Nevada, and southern California. The bobcats distribution is spotty from coast to coast, though scarce or absent in much of the Midwest. The Marten occupies the extreme north of the United States, extending spotty distribution into California and the Rocky Mountains and New England. Most of the United States, except Arizona, southern California, southern and central Utah, southern New Mexico and western Texas is typically home to the mink. The muskrat's range encompasses most of the United States and Canada except for the Arctic regions, much of California and the southwest, Texas and Florida. The least weasel can be found in most of Canada, south into the Midwest of the United States, northeastern Montana, Nebraska, Iowa, northern Illinois, northern Indiana, Ohio, Pennsylvania, West Virginia, and the southern Appalachian Mountains.

Indicators

WGFD biologists use furbearer/trapper harvest survey results to monitor populations of these species and make hunting season recommendations.

Current Conditions

Badger, bobcat, and weasel are habitat generalists, occupying all vegetative types in the planning area with appropriate prey base. Marten primarily utilize mixed-conifer forest and aspen communities in the ponderosa and lodgepole pine forests and the aspen, juniper, and limber pine woodlands vegetative types. Beaver, muskrat, and mink typically are present in the aspen and riparian and wetland vegetative types. Due to the wide distribution of other furbearing animals throughout Wyoming, no management challenges have been identified for the planning area. The primary BLM management effort is directed toward maintaining the continuity of ecosystems in the planning area.

Trends

Furbearer population trends in the planning area are not known at this time. Population figures are available only on a statewide basis. Trapping seasons apply to most furbearers. These populations likely fluctuate as a result of naturally occurring phenomena such as drought, fire, and floods. Population fluctuations of their prey base also affect furbearer abundance.

Predatory Animals

According to Wyoming statute, predatory animals in the planning area include coyote, red fox, raccoon, porcupine, skunk, and jackrabbit. These species may be hunted or trapped without a license, and there is no closed season.

Regional Context

Historic coyote distribution occurred throughout eastern and southern Alaska, southern and western Canada, and all of the western United States, but is now believed to extend throughout the entire United States. The red fox can be found throughout most of Canada and the United States, except for the far north, northwestern British Columbia, much of the western United States and southern Florida. Raccoons range from southern Canada through most of the United States, except portions of the Rocky Mountains, central Nevada, Utah, and Arizona. Porcupine distribution encompasses most of Canada and the western United States, south to Mexico and in the east, south to Wisconsin, the northern half of Michigan, most of Pennsylvania, New York, and New England. Most of the United States and Canada is home to skunk. Jackrabbits can be found in the western Untied States form south-central Washington, south to California, east to Nebraska, western Missouri and Texas.

Indicators

No indicators for predatory animals are available at this time.

Current Conditions

USDA APHIS-Wildlife Services conducts predatory animal damage-control activities on public lands in accordance with the national MOU and local action plans (BLM 2000a). APHIS-Wildlife Services performs these activities in response to requests from individuals, organizations, and agencies experiencing damage caused by wildlife. Animal damage-control activities primarily include mechanical (trapping, shooting, and denning), chemical (poison), and nonlethal methods (e.g., noise devices and aversive conditioning). Through the Animal Damage Management Board, the State of Wyoming also performs animal damage-control activities, particularly actions involving rabies and other diseases.

The management challenge for animal damage-control activities is to implement a program that responds to predation problems and remains socially acceptable and safe in accordance with applicable laws and regulations. The BLM does not perform any habitat management activities for predatory animals. An overabundance of predatory animals can be devastating to prey populations. Future management of BLM-authorized activities should incorporate BMPs aimed at reducing supplemental habitat for predatory species throughout the planning area.

Trends

Predatory animal population trends in the planning area are not known at this time. CBNG infrastructure such as roads, pipeline corridors, and nearby metering facilities provides shelter and den sites for ground predators such as skunks and foxes. These populations likely fluctuate as a result of naturally occurring phenomena such as drought, fire, and floods. Population fluctuations of their prey base also affect these animals' populations.

Nongame Animals

The following paragraphs briefly describe existing conditions for four categories of nongame wildlife (raptors, neotropical migrants, mammals, and reptiles and amphibians). Raptors and neotropical migrants are afforded protection under the Migratory Bird Treaty Act. Additional detail about nongame wildlife in the planning area can be found in the WGFD *Atlas of Birds, Mammals, Amphibians and Reptiles in Wyoming* (Cervoski et al. 2004). Also, the *Wyoming Partners in Flights Wyoming Bird Conservation Plan* identifies priority bird species and habitats, and population and habitat objectives for birds (Cerovski et al. 2001).

Raptors

Raptor species (eagles, hawks, owls, and falcons) in the planning area include the bald eagle, golden eagle, American kestrel, Cooper's hawk, ferruginous hawk, northern harrier, northern goshawk, red-tailed hawk, Swainson's hawk, great horned owl, short-eared owl, long-eared owl, western burrowing owl, peregrine falcon, and prairie falcon. Less common raptors in the planning area include osprey and merlin. Raptors are present in habitats throughout the planning area. Raptors are sensitive to environmental disturbance and occupy an ecological position at the top of the food chain; therefore, they act as biological indicators of environmental quality. Several of these species (bald eagle, ferruginous hawk, northern goshawk, peregrine falcon, Swainson's hawk, and western burrowing owl) are further addressed in the *Special Status Species – Wildlife* section. Appendix K (p. 1749) identifies these and other raptor species of interest to agencies and groups in the planning area.

Indicators

Key efforts for monitoring include annual breeding bird surveys and strategies outlines within the Wyoming Bird Conservation Plan. Additionally, the WGFD is involved in a variety of single species monitoring efforts related to raptors, waterfowl, and a few upland birds.

Current Conditions

Most species have specific nest-site requirements, which are key factors in nest-site selection and in reproductive success. These generally include nesting strata, available prey base, and nest-site disturbance. Nests can be present in a myriad of habitats, including steep cliffs and rock ledges, trees, and on the ground. Individual raptors tolerant of human activity might nest on manufactured structures such as barns, utility poles, and tanks. The nesting-reproductive season is considered the most critical period in the raptor life-cycle because it determines population productivity, short-term diversity, and long-term trends. Current management restricts or prohibits surface occupancy within a biologic buffer of a raptor nest and does not allow surface use within 0.5 mile of a nest between February 1 and July 31. The BLM authorized officer may grant exceptions to both restrictions.

Management challenges for raptors generally involve activities around nesting habitat, concentration sites (e.g., winter roosts), and foraging areas. Management of powerlines and contaminants for raptor conservation are ongoing issues in the planning area. Emerging issues for raptors in the planning area are energy development and impacts to raptor species from the West Nile virus. Human activities close to active raptor nests interfere with nest productivity. Romin and Muck (2002) indicate that activities within 0.5 mile of a nest are prone to cause adverse impacts to nesting raptors. If mineral activities occur during nesting, they could be sufficient to cause adult birds to remain away from the nest and their chicks for the duration of the activities. This absence can lead to overheating or chilling of eggs or chicks. Prolonged disturbance can also lead to adult abandonment of the nest. Both actions can result in egg or chick mortality. In addition, routine human activities near these nests draw increased predator activity to the area and increase nest predation.

Management direction for the BLM is identified in the BLM *Fish and Wildlife 2000 Raptor Habitat Management Plan* (BLM 1992b). Management procedures and activities for raptors are identified by the USFWS management guidelines (USFWS 2009) and Avian Protection Plan guidelines (Avian Power Line Interaction Committee 2006). The *Wyoming Partners in Flight Wyoming Bird Conservation Plan* identifies habitat requirements and threats for raptor species

(Cerovski et al. 2001). Approximately 13,100 raptor nests have been documented in the planning area. Not all these nests are occupied; however, the BLM and the WGFD regularly survey and monitor raptor nest activity.

The following sections briefly describe the regional contexts, current conditions, and trends for the raptor species that may occur within the planning area that are not considered special status species.

- Golden Eagle

Regional Context

In North America, this species occurs throughout the mountain and grassland regions where medium-sized mammals are available and abundant (Glinski 1998). Golden eagles typically nest on open cliffs or in trees (in the planning area, most often cottonwoods). Important foraging habitats include grasslands, sagebrush, and farmlands (Barrett 1998a). Golden eagles are protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, two statutes that are considered during the project planning and approval processes.

Current Conditions

In Wyoming, this species is considered a common year-round resident, feeding mostly on jackrabbits, rodents, small mammals, and carrion in winter (Orabona et al. 2012).

Trend

Golden eagle populations in Wyoming should remain relatively stable in the foreseeable future. However, if urbanization and industrial development continue in the state, the amount of available nesting and hunting habitat will decline. The net result will most likely be a minor reduction in eagle numbers (Phillips et al. 1984).

- American kestrel

Regional Context

The American kestrel is present throughout North and South America from Alaska south to the southernmost tip of South America. This species is known to breed in every state in the United States except Hawaii, and in every province of Canada.

Current Conditions

American kestrels prefer open country with sufficient perches (e.g., dead trees, rocky outcrops, and utility poles and wires) for hunting insects and small mammals (Winn 1998). Nesting sites often include tree cavities, crevices, cliffs, and nest boxes. Most commonly found along riparian corridors, kestrels forage for mice and voles, but would also take larger invertebrates (e.g., grasshoppers) where other prey is limited. In Wyoming, the kestrel is a very common summer resident of suitable habitats below 8,500 feet elevation.

Trends

Declines in American kestrel populations are widely reported, and Breeding Bird Survey (BBS) data suggests that the North American population declined substantially from 1984 to 2007. Population declines are attributed to habitat loss and degradation and non-breeding season mortalities (Smallwood et al. 2009). Additional factors that have been identified as causes for declining kestrel numbers that warrant further investigation include poisoning by pesticides in agricultural areas, increased predation by Cooper’s hawks, and West Nile virus (Farmer and Smith 2009).

- Cooper’s hawk

Regional Context

Cooper's hawk is native to the North American continent and found from Canada to Mexico.

Current Conditions

The breeding pair builds a stick nest in a large tree. These birds capture prey from cover or while flying quickly through dense vegetation, relying almost totally on surprise. Birds preyed on can range in size from wood-warblers to ring-necked pheasants. Cooper's hawks also eat small mammals, especially rodents such as chipmunks and tree squirrels. Mammalian prey can be as small as mice and as large as hares. Other possibilities are lizards, frogs, snakes, and large insects. Cooper's hawks are increasingly seen hunting smaller songbirds in backyards with feeders.

Trends

In Wyoming (Keinath et al. 2003) and Montana (Bergeron et al. 1992), these hawks are considered to be common and do not have any special conservation status. In Montana, raptor survey results from 1977 to 2004 showed increasing, though not substantial, numbers of Cooper’s hawks detected. Populations in the west overall appear to be relatively stable (Atkinson 2005).

- Northern Harrier

Regional Context

This species is present throughout much of North America, with highest densities in the prairie pothole region of the United States and Canada.

Current Conditions

Harriers nest in a variety of habitats, including native and non-native grasslands, agricultural lands, emergent wetland marshes, and mountain sagebrush (Carter 1998a). In Wyoming, this species is a common summer resident, feeding mostly on small mammals (often voles) that it discovers while gliding (Orabona et al. 2012).

Trends

Harrier numbers at migration sites have shown increases, with the majority occurring in western Montana (eight out of 45 sites surveyed in Montana form 1977 to 2004) (Atkinson 2005).

- Red-tailed Hawk

Regional Context

Red-tailed hawks use a variety of habitats and range from Alaska south to Panama and east to Nova Scotia and the Virgin Islands (Preston 1998b). This species typically nests in patches of tall trees or on secluded cliff faces, but will also use tree windbreaks where available.

Current Conditions

In Wyoming, this species is considered a year-round resident common to most habitats below 9,000 feet, including prairie grasslands, riparian areas, sagebrush communities, and pinyon/juniper woodlands (Orabona et al. 2012). They nest mainly in trees and are more tolerant of human activities than are other raptors. Typical prey species include rodents and other small mammals.

Trends

In Montana, from 1977 to 2004, red-tailed hawk population trends have shown an average annual increase of 20.14%. Western red-tailed hawk populations have shown upwards trends for some time, likely resulting from a positive response to habitat fragmentation and human-caused changes in the landscape (Atkinson 2005).

- Prairie Falcon

Regional Context

The prairie falcon ranges over the western half of North America from southern Alberta, Saskatchewan, and British Columbia south to central Mexico (Jones 1998b). This species nests almost exclusively on tall cliff faces. Prairie falcons hunt birds and small mammals from perches and while soaring.

Current Conditions

In Wyoming, the prairie falcon is considered a common resident, nesting in cliff habitats in open areas (Orabona et al. 2012). Where nesting substrates are present, as at the Pumpkin Buttes, several pairs can be found near one another; however, large areas of otherwise suitable habitats can be unoccupied if nesting substrates are absent.

Trends

Fifty-eight percent of the 43 occupied routes surveyed in Montana showed decreases (1977 to 2004) in numbers of prairie falcons observed, four of which were important. Three routes showed increasing rates. Montana's increasing rates of prairie falcons observed in similar to western migration route sites, however, some western populations have declined steeply in the last 30 years (Atkinson 2005). These declines are likely contributed to habitat loss (Steenhof et al. 2005).

- Great Horned Owl

Regional Context

The great horned owl is present from the northern edge of the boreal forest in Alaska and Canada to the southern tip of South America. This owl typically nests in wooded areas adjacent to open spaces such as shrublands, grasslands, and farm fields that provide excellent opportunities for hunting rodents and other small mammals (Boyle 1998a).

Current Conditions

In Wyoming, this owl is considered a common resident of most habitats below 9,000 feet, especially in riparian areas dominated by cottonwood (Orabona et al. 2012). Great horned owls are tolerant of human activities and will nest in a variety of structures, including industrial facilities. The nesting density of this owl varies from 18.5 to 40 square miles per pair, although the secretive nature of the species makes nest detection difficult (BLM 2003c).

Trends

Population trends appear to be stable, though no local data is available for the great-horned owl.

- Short-eared Owl

Regional Context

The short-eared owl is present throughout Canada and the central and northern United States.

Current Conditions

In Wyoming, this species is a common year-round resident (Orabona et al. 2012). This owl is a ground-nesting species, building its nest of grasses, weeds, and down feathers in short- and mixed-grass prairies and herbaceous wetlands (Boyle 1998b).

Trends

Density of nesting short-eared owls appears to be highly variable and is based on the abundance of voles and other small mammals (BLM 2003c). Data from BSS and Christmas Bird Counts (CBC) show substantial declines in both breeding and wintering populations in Wyoming. Factors most likely responsible for declines in the populations are low reproductive success and poor overwintering survival, likely tied to loss or degradation of suitable nesting and/or foraging habitat, habitat fragmentation, and consequent decreases in prey abundance.

- Long-eared Owl

Regional Context

A bird of temperate forests, the long-eared owl roosts and nests in trees by day and hunts in open areas by night. Although widespread and relatively common in its range, it is rarely seen. Common habitat includes dense vegetation adjacent to open grassland or shrubland, and open forests. This owl typically uses stick nests built by other bird species, including black-billed magpie, American crow, and hawks. In rare cases, this owl nests in cavities. Like most owl species, the long-eared owl hunts almost exclusively at night, flying low over open ground, locating prey by ear.

Current Conditions

In Wyoming, breeding home range in riparian habitat varies from 34 to 106 hectares (83 to 262 acres), and averages 51 hectares (134 acres) (Craighead and Craighead 1956).

Trends

Populations of long-eared owls appear to be stable in most of North America, although they have declined in some areas due to habitat loss. Local trends are unavailable.

- Osprey

Regional Context

The osprey tolerates a wide variety of habitats, nesting in any location near a body of water that provides an adequate food supply. It is present on all continents except Antarctica, although in South America it is present only as a non-breeding migrant. The osprey's diet consists almost exclusively of fish. In North America, it breeds from Alaska and Newfoundland south to the Gulf Coast and Florida, wintering farther south from the southern United States through to Argentina.

Current Conditions

In Wyoming, this species breeds by freshwater lakes and streams. The nest is a large heap of sticks, built in forks of trees, on rocky outcrops, on utility poles, or on artificial platforms.

Trends

Mean annual increases of osprey migration site surveys in Montana equaled nearly fifty-six percent from 1997 to 2004. Osprey populations appear to be in incline likely resulting from decreased DDT use and provision of nesting structures (Atkinson 2005).

- Merlin

Regional Context

Merlin nest in boreal forests below tree line from coast to coast and along the western mountains south to Oregon, Idaho, and Montana. It winters in southern latitudes from the southern United States to South America (Udvardy 1977).

Current Conditions

In Wyoming, this species is an uncommon resident in a diversity of habitats below 8,500 feet, including open grasslands and shrublands and coniferous forests (Orabona et al. 2012). In the planning area, merlin often lay their eggs in abandoned black-billed magpie nests. Most merlin nests in the planning area are known from Rochelle Hills in southeastern Campbell County (BLM 2003c). Merlin typically rely on locally abundant populations of small birds as prey species, but will also prey on toads, reptiles, and mammals (BLM 2003c). This species is a documented breeder throughout much of Wyoming, including the planning area (Orabona et al. 2012). This species can be present in suitable habitats in the planning area.

Trends

Generally stable migration counts have been seen throughout western migration sites, with slight increases noted at the Montana sites (Atkinson 2005).

Summer and Year-round Resident and Neotropical Migrant Birds

Regional Context

Neotropical migrants are birds that migrate long distances from wintering grounds in the New World tropics of Central and South America to breeding grounds in North America. A wide variety of summer and year-round resident and neotropical migrants use the planning area during migration or the breeding season. This category includes shorebirds, water birds, and songbirds.

Current Conditions

These species could use all habitat types in the planning area; the highest level of use by the most species occurs in the more productive and diverse habitats (e.g., forested riparian areas). Shrub-steppe habitats (sagebrush shrublands and other shrublands in part) and short-grass prairie habitats are both common in the planning area and are of critical importance to some of these species (Rothwell 1992).

Many species of high concern to management because of declining populations use shrub-steppe and short-grass prairie areas for their primary breeding habitats (Saab and Rich 1997). The *Special Status Species – Wildlife* section of this chapter addresses those BLM sensitive species. In response to concerns about neotropical migrants, the *Wyoming Bird Conservation Plan* (Cerovski et al. 2001) identifies two groups of high-priority species in Wyoming. Appendix K (p. 1749) lists the migratory bird species of management concern in Wyoming not addressed elsewhere in this chapter and known or expected to occur in the planning area (Orabona et al. 2012).

Management challenges focus around maintaining, enhancing, or restoring the presence of these species and the habitats upon which they depend. Ongoing conservation issues include managing hazards such as habitat degradation, powerlines, communications towers, and contaminants.

CBNG-related activities are affecting migratory bird populations in the planning area. Loss and degradation of habitats has occurred, as has disturbance to individual birds resulting from construction and production activities. In areas of concentrated development, breeding density of some species could have been reduced because of these and other impacts. Species specific to grassland and shrub-steppe habitats and sensitive to disturbance and habitat fragmentation have likely been the most affected. Human activities likely displace migratory birds farther than simply the physical habitat disturbance. Drilling and construction noise can be troublesome for songbirds by interfering with the males' ability to attract mates and defend territory, and the ability to recognize calls from conspecifics (BLM 2003c).

Habitat fragmentation results in more than just a quantitative loss in the total area of habitat available; the remaining habitat area is also qualitatively altered (Laudenslayer 1986). Ingelfinger and Anderson (2004) identified that the density of breeding Brewer's sparrows declined by 36% and breeding sage sparrows declined by 57% within 100 meters (approximately 30 feet) of dirt roads in a natural-gas field. Impacts occurred along roads with light traffic volume (fewer than 12 vehicles per day). The increasing density of roads constructed in developing natural-gas fields exacerbated the problem, creating substantial areas of impact where indirect habitat losses (displacement) were much greater than the direct physical habitat losses.

Reclamation and other activities in spring could be detrimental to migratory bird survival. Edge-sensitive species will be displaced farther away from vegetative edges due to increased human activity, causing otherwise suitable habitat to be abandoned. If the interior habitat is at carrying capacity, then birds displaced from the edges will have no place to relocate. One consequence of habitat fragmentation is a geometric increase in the proportion of the remaining habitat that is near edges (Temple 1986). In severely fragmented habitats, all of the remaining habitat might be so close to edges that no interior habitat remains (Temple and Cary 1988). Over time, this will lead to a loss of interior habitat species in favor of edge habitat species. Other migratory bird species that utilize the disturbed areas for nesting could be disrupted by the human activity and equipment could destroy nests.

The use of the proposed water treatment facilities increases the potential for migratory bird mortality in the evaporation ponds that receive a backwash stream from the conditioning ponds. This evaporation pond will contain a concentrated brine solution. Birds entering this pond can ingest the brine and die from sodium toxicity. Salt toxicosis has been reported in ponds with sodium concentrations of more than 17,000 milligrams per liter. Ingestion of water that contains high sodium levels can chronically affect aquatic birds, especially if a source of fresh water is not available nearby. Aquatic birds ingesting hypersaline water can be more susceptible to avian botulism. During cooler temperatures, sodium in the hypersaline water can crystallize on the feathers, affecting thermoregulatory and buoyancy functions, and causing the bird to die of hypothermia or drowning (Windingstad et al. 2004). Effective wildlife exclusionary devices, such as netting, are required to prevent access by migratory birds, or other options should be utilized to contain and dispose of the brine solution should sodium concentrations rise to more than 17,000 milligrams per liter.

Migratory bird species in the Powder River Basin nest in spring and early summer and are vulnerable to the same affects as raptor species. Although the BLM typically does not apply timing restrictions specifically to protect migratory bird breeding or nesting, where Greater Sage-Grouse or raptor nesting timing limitations are applied to BLM-authorized activities, nesting migratory birds are also protected. Where these timing limitations are not applied and migratory bird species are nesting, migratory birds remain vulnerable.

Neotropical migrant management direction for the BLM is identified in the BLM *Fish and Wildlife Nongame Migratory Bird Conservation Plan* (BLM 1992b). *Wyoming Partners in Flight Wyoming Bird Conservation Plan* provides habitat requirements for neotropical migrant species and identifies their threats (Cerovski et al. 2001).

Trends

Ground-nesting birds are exhibiting decreasing population trends due to increased human-adapted predator populations. Similarly, disturbance-sensitive species are exhibiting decreasing population trends due to disruptive human activity (e.g., OHV use, recreation, livestock grazing, construction of oil and gas wells, roads, pipelines, powerlines, mines, and livestock facilities) within important buffer zones or during critical periods (e.g., breeding or nesting) (Cerovski et al. 2001; Vander Haegen et al. 2002; Ingelfinger and Anderson 2004).

Mammals

Fifty species of nongame mammals, including species such as gophers, mice, rats, voles, ground squirrels, shrews, bats, otters, and prairie dogs are known or suspected to be present in the planning area (WGFD 2006c).

Regional Context

For a complete habitat description and distribution of nongame mammals, refer to the *Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming* (Cervoski et al. 2004). Most nongame mammals are widely distributed in the state. These species are present in habitats throughout the planning area.

Six mammal species (black-tailed prairie dog, fringed myotis, long-eared myotis, spotted bat, swift fox, and Townsend's big-eared bat) are considered BLM sensitive species and further addressed in the *Special Status Species – Wildlife* section. Appendix K (p. 1749) lists the mammal species of management concern in Wyoming not discussed elsewhere in this document and known or expected to be present in the planning area (Orabona et al. 2012).

Current Conditions

Although these species utilize a wide variety of habitats, caves and abandoned mines represent important habitat components upon which the bat species depend for roosts, nurseries, and hibernacula. Very little habitat components have been delineated on public lands in the planning area. Inventories thus far have revealed bat occupied caves within the Southern Bighorns and in the foothills of the Big Horn Mountains in Sheridan County. WNS is caused by a fungus, and has become a threat to bats in the eastern United States, but has not been detected in Wyoming (BLM 2010d; Abel and Grenier 2011). Cave and abandoned mine-hibernating bats are at risk of contracting a fungus, *Geomyces destructans,* which invades and erodes the skin of hibernating bats, causing the bats to arouse more frequently and deplete fat stores more rapidly, which could result in mortality. Deaths can result from *Geomyces destructans* infection through starvation, dehydration, and exposure to cold temperatures (Abel and Grenier 2011).

Management challenges currently focus on increasing the understanding of habitat requirements for these species and maintaining the presence of these species in occupied habitats. Ongoing conservation efforts for nongame mammals include managing invasive species and managing hazards such as contaminants and developments.

Trends

Population trend data and specific habitat requirement information are lacking for many of these species.

Reptiles/Amphibians

Reptiles and amphibians known to be present in the planning area include one salamander species, three toad species, five frog species, three turtle species, two lizard species, and seven snake species (WGFD 2006c).

Regional Context

For a complete habitat description and distribution of reptiles and amphibians in the planning area, refer to the *Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming* (Cervoski et al. 2004).

Current Conditions

In general, reptile habitats in the planning area include aquatic (turtles), rocky outcrops (lizards), and a variety of terrestrial vegetative types (snakes and lizards occupy a variety of habitats). Amphibians in the planning area occupy aquatic habitats, including springs, wetlands, riparian corridors, or open water for the first phase of their life-cycles. Amphibians present in the planning area include tiger salamanders, toads, and frogs. Population data for reptiles and amphibians in the planning area are not available.

Management challenges for reptiles and amphibians primarily include maintaining a variety of habitat types and components, including crucial habitat elements (e.g., rocky outcrops) nearby to provide for the requirements of these species.

Trends

In general, combined results form WYNDD surveys in 2008 and 2009 show that boreal chorus frogs and Woodhouse's toads currently have the highest site occupancy rates in the Powder River Basin based on nocturnal call surveys (Estes-Zumph et al. 2010). Tiger salamander mortality was documented at sixty-three percent of standing water bodies surveyed in 2009, a marked increase from the twenty-five percent of sites found to contain dead salamanders in 2008. Ranavirus infection has been found as the cause for these mortalities. It is unknown if the ranavirus outbreak is natural or if changes in water quality in the Powder River Basin could be increasing susceptibility of tiger salamanders to the virus. Other amphibians do not seem to by impacted by the virus (Estes-Zumph et al. 2010).

3.4.6.4. Trends

Historic activities from agriculture, development, fire management, OHV use, recreation, and transportation have, in some areas, contributed to the degradation of wildlife habitats in the planning area. In other areas, historic activities have improved habitats or the ability to manage wildlife habitats.

Examples of historic activities that have contributed to the degradation of wildlife habitats include livestock concentration areas (e.g., water sources), in which vegetation has been trampled and removed and vegetation and soil has been compacted; utility and pipeline corridor installation, which has disturbed soil and provided opportunities for the spread of invasive plant species; fire suppression, which might have altered the natural fire regime with which habitats evolved; oil and gas well and associated infrastructure development, which has disturbed soil for well pad and road development, thereby contributing to soil erosion and habitat fragmentation; improper OHV use, which has spread invasive plant species and disturbed wildlife; recreation activities, which have disturbed wildlife; and road placements, which have contributed to habitat fragmentation in the planning area. These historic activities have occurred to varying degrees in the planning area. Consequently, wildlife habitats in the planning area exhibit a range of existing conditions, from habitats in PFC to habitats in something less than PFC, and from large, contiguous blocks of habitat to small, fragmented patches. Examples of historic activities that have improved wildlife habitats or improved the management of habitats in the planning area include prescribed fire to maintain or restore desirable vegetative types and restore a natural fire regime; livestock water developments as sediment traps and as water sources for native ungulates and other wildlife; use of OHVs to manage and monitor wildlife habitat in remote locations in the planning area; and granting public access for hunting as a tool for big game management.

Wells, roads, pipelines and other infrastructure associated with energy development constructed in prairie dog colonies directly removes habitat for prairie dog colony-obligate species. Activities that disturb these species could lead to temporary or long-term (permanent) abandonment. Continued loss of prairie dog habitat and active prairie dog towns will result in the decline of numerous sensitive species in the short-grass prairie ecosystem.

Shrubland and grassland birds are declining faster than any other group of species in North America (Knick et al. 2003). In Wyoming, existing oil and gas wells are located primarily in landscapes dominated by sagebrush, causing direct habitat loss. Associated road networks, pipelines, and powerline transmission corridors also influence vegetation dynamics by fragmenting habitats or by creating soil conditions and facilitating the spread of invasive species (Braun 1998; Gelbard and Belnap 2003). Density of sagebrush-obligate birds within 100 meters (approximately 330 feet) of roads constructed for natural gas development in Wyoming was 50% lower than at greater distances (Ingelfinger 2001). Increased numbers of corvids and raptors associated with powerlines (Steenhof et al. 1993; Knight and Kawashima 1993; Vander Haegen et al. 2002) increases the potential predation impact on Greater Sage-Grouse and other sagebrush breeding birds (Knick et al. 2003). Fragmentation of shrub-steppe has the further potential to affect the conservation of shrub-obligate species because of the permanence of disturbance (Knick and Rotenberry 1995). Several decades are required to reestablish ecologically functioning mature sagebrush communities. Therefore, sagebrush-obligate species might not return even after habitat is reestablished.

There is considerable potential for habitat restoration due to the extent of only partially modified grazing lands. However, oil and gas development and the creation of road networks are very considerable factors, and tame grazing and hay crops are increasingly replacing more native grasslands. A combination of oil and gas pipelines and the road network contributed to further dissection of the landscape.

3.4.6.5. Key Features

Key features for special status wildlife species include: riparian corridors (see key features in the *Fish and Wildlife Resources – Fish* section) and the following:

- *Prairie Dog Colonies* – Prairie dogs have been described as a keystone species and an ecological engineer. They build prairie dog towns, which provide habitat for more than 170 species. Of species regularly associated with prairie dog colonies, six are on the BLM Wyoming sensitive species list – swift fox, mountain plover, ferruginous hawk, western burrowing owl, loggerhead shrike, and long-billed curlew. This biodiversity issue is relevant in the planning area.
- *Sagebrush Steppe Ecosystems* – Sagebrush steppe ecosystems support a variety of species. Sagebrush obligates are animals that cannot survive without sagebrush and its associated perennial grasses and forbs; that is, species that require sagebrush for some part of their life-cycle. Sagebrush obligates in the Powder River Basin, listed as sensitive species by BLM Wyoming, include Greater Sage-Grouse, Brewer's sparrow, sage thrasher, and sage sparrow.

3.4.7. Special Status Species – Plants

3.4.7.1. Regional Context

Regional context for each species is included below in each species description.

3.4.7.2. Indicators

Special status plants are present in a variety of habitats in the planning area. The landscape in the planning area exhibits diverse climates, topography, soils, and vegetative communities. Because riparian systems comprise only two percent of the land cover types in the planning area, these areas become vitally important for their species richness. Some species prefer higher altitude, alpine riparian, others prefer lower riparian systems associated with open grassland, and all zones in between. Species prefer soil gradients from deep, organic rich soils to shallow gravelly sites. Some can only be found on the edges of snowlines, the forest understory, and in drying mud of ponds; others in dry sandy prairie; and others prefer disturbed sites.

3.4.7.3. Current Condition

One Threatened plant species, Ute ladies'-tresses orchid, could be present in the planning area. There also are three BLM Wyoming-listed sensitive plant species in the planning area (Table 3.35, “Special Status Plant Species Potentially Present in the Planning Area” (p. 355)). Appendix K (p. 1749) lists plant species of special concern to other agencies and groups in the planning area.

Table 3.35, “Special Status Plant Species Potentially Present in the Planning Area” (p. 355) lists habitat associations for special status plants known to be or that could be present on BLM-administered land in the planning area. The Wyoming Natural Diversity Database has modeled special status plant habitat throughout the planning area. In addition, surveys have been conducted, extensively in some areas, however, few populations have been identified and therefore, there is little information about the locations and numbers of populations of special status plant species in the planning area.

Table 3.35. Special Status Plant Species Potentially Present in the Planning Area

Common Name	Habitat	Status
Ute ladies’-tresses orchid	Moist stream banks, wet meadows, and abandoned stream channels. Elevation 5,100 to 5,200 feet. Flowering period: July – September.	Federally listed Threatened
Limber pine	Dominates on dry, rocky sites at many elevations (4,900 to 9,800 feet) within its range. It can occur scattered throughout forested regions on more mesic sites, especially in low density, open areas.	BLM Wyoming-listed sensitive
Porter's sagebrush	Sparsely vegetated badlands of ashy or tufaceous mudstone and clay slopes. Elevation 5,300 to 6,500 feet. Flowering period: June – July.	BLM Wyoming-listed sensitive
Williams’ waferparsnip	Open ridgetops and upper slopes with exposed limestone outcrops or rockslides. Elevation 6,000 to 8,300 feet. Flowering period: May – June.	BLM Wyoming-listed sensitive
Source: BLM 2010e BLM Bureau of Land Management		

Ute Ladies’-tresses Orchid (Federally Threatened)

Regional Context

The Ute ladies’-tresses orchid is known to occur in Converse, Goshen, Laramie, and Niobrara counties of eastern Wyoming, with habitat and predicted population occurrences noted in southern Campbell County (Heidel 2007; Fertig 2000b) (Map 28). More than 50% of the continental range of this species is in Wyoming.

Current Condition

The Ute ladies’-tresses orchid is ranked as rare at the global level, critically imperiled at the state level, and Threatened at the federal level. Habitat for this perennial orchid includes riparian and wet meadow habitats. A very low number (one to five) of occurrences are documented for this species and it is rare (fewer than 5,000 individuals or less than 400 occupied acres) in abundance. Threats to this species include water developments, intense domestic livestock grazing, hay mowing, competition from invasive species, habitat fragmentation, urbanization, and collection by humans (Fertig 2000b; USFWS 1992). In 2004, the USFWS initiated a 5-year status review to determine if delisting this species is warranted (USFWS 2004). The USFWS has not yet released the results of the review, and the plant continues to be listed.

Trends

Based on limited census data and loss or conversion of riparian habitat throughout its range, populations of Ute ladies'-tresses orchids are thought to be declining.

Limber Pine (BLM-listed Sensitive)

Regional Context

Limber pine occurs throughout western North America, from British Columbia and Alberta in Canada south into the United States to Arizona and New Mexico and from the coasts of California and Oregon, east to the Dakotas, Nebraska and Colorado.

Current Conditions

Limber pine are located in the western portion of the planning area along the timberline of the Big Horn Mountains and also along the side slopes of the Pumpkin Buttes in the southeast region of the planning area. Limber pine are a long-lived, but slow growing member of the pine family. In Wyoming, limber pine is distributed from 5,000 feet to over 10,000 feet in elevation, ranging from high elevation timberline to the woodland/grass/sagebrush ecotone. Associated species in Wyoming include Rocky Mountain lodgepole pine, Engelmann spruce, whitebark pine, Rocky Mountain Douglas-fir, subalpine fir, Rocky Mountain juniper, Mountain Mahogany, and common juniper. This species has been declining. The major threats are white pine blister rust, dwarf mistletoe species, increases in mountain pine beetle, fire suppression, climate change, and their synergistic effects.

Trends

Limber pine has been undergoing a downward trend and it is estimated that approximately 50% of stands currently are dead or dying in Wyoming (BLM 2010e).

Porter's Sagebrush (BLM-listed Sensitive)

Regional Context

Porter's sagebrush is endemic to the Wind River Basin and Powder River Basin in Fremont, Johnson, and Natrona counties in Wyoming (Fertig 2000a).

Current Conditions

This species occurs primarily in sparsely vegetated Artemisia pedatifida, A. longifolia, or A. porteri communities on clay flats, badlands slopes, depressions, or gullies at 4,600 to 7,000 feet elevation. The major potential threats are oil and gas and mining development, invasive species, such as cheatgrass, and vehicle disturbance (Fertig 2002). Specialized ecological refugia are threatened and Porter's sagebrush is thereby designated as sensitive.

Trends

Long-term trend data are not available for most populations of Porter's sagebrush. Although some habitat has been altered or lost during oil and gas developments throughout Wyoming, the overall population of Porter's sagebrush in central Wyoming is probably stable.

William's Waferparsnip (BLM-listed Sensitive)

Regional Context

This perennial umbel is endemic to limestone habitats in the Big Horn Mountains.

Current Conditions

A moderate number (21 to 75) of occurrences are documented for William's waferparsnip. This species is uncommon (5,000 to 50,000 individuals or 500 to 5,000 occupied acres) in abundance, and distribution is limited to four counties in Wyoming, including Johnson.

Trends

Populations are thought to be stable in part because habitat is often inaccessible and cattle and sheep apparently do not graze this species. However, limestone quarrying and other ground disturbance could threaten this species.

3.4.7.4. Trends

In addition to those listed for each species, most of the trends that affect other plant species in the planning area also affect special status species. These include habitat degradation and fragmentation, grazing practices and management, invasive species, motor vehicles, and climate.

Management of special status plant species in the planning area presents a number of challenges, including declining population trends for select species, drought and other natural events, spread and control of invasive species, maintaining PFC for riparian and wetland habitats, vegetation treatment with prescribed fire or herbicides, lack of periodic disturbance events (e.g., fire, flood, and grazing), physical trampling (e.g., OHV use), loss of habitat resulting from altered hydrology, and challenges presented by special status plant populations occurring over multiple land ownerships. While threats to some species could remain low due to the remoteness of their habitats, threats to other species could increase despite distance or restricted access. For example, special status plant species that depend on groundwater levels could be affected by upstream depletions of groundwater far removed from affected populations. Moreover, early successional special status plant species protected from habitat alteration could still be adversely affected by natural succession and the lack of fire, flooding, or other disturbance factors necessary to retain early successional habitat.

3.4.7.5. Key Features

Ute ladies'-tresses orchid is listed as Threatened under the Endangered Species Act. It is extremely rare and occurs in moist, sub-irrigated or seasonally flooded soils at elevations between 1,780 and 6,800 feet above sea level (Map 28). Habitat includes wet meadows, abandoned stream channels, valley bottoms, gravel bars, and near lakes or perennial streams that become inundated during large precipitation events. The Wyoming Natural Diversity Database model predicts undocumented populations could be present, particularly in southern Campbell County and northern Converse County.

Before 2005, only four populations of Ute ladies'-tresses orchids had been documented in Wyoming. Five additional sites were identified in 2005 and one in 2006 (Heidel 2006). The new locations were in the same drainages as the original populations, with two on the same tributary and within a few miles of an original location. Drainages with documented populations include Wind Creek and Antelope Creek in northern Converse County, Bear Creek in northern Laramie County and southern Goshen County, Horse Creek in Laramie County, and the Niobrara River in Niobrara County.

3.4.8. Special Status Species – Fish

3.4.8.1. Regional Context

The only special status fish in the planning area is the Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*). This subspecies of cutthroat is found in the Little Bighorn and Tongue River drainages on the Northeastern corner of the Big Horn Mountains. These drainages are located along the eastern edge of the Yellowstone cutthroat trout's native range.

3.4.8.2. Indicators

The BLM is responsible for managing habitat for special status species fish. Special status species considered in this analysis are those listed as Threatened or Endangered, those proposed for listing or that are candidates for listing under the provisions of the Endangered Species Act, and those designated by the BLM State Director as sensitive. For a discussion of indicators related to fish species, see the *Fish and Wildlife Resources – Fish* section of this chapter.

3.4.8.3. Current Condition

Special status species fisheries habitats include perennial and intermittent streams that support Yellowstone cutthroat trout fish through at least a portion of the year. Yellowstone cutthroat trout historically occur in the Tongue River and Little Bighorn River drainages. For a discussion of water quality and water quantity in the planning area, see the *Water* section of this chapter.Table 3.36, "Special Status Fish Species in the Planning Area" (p. 358) lists fish species that could be present in the planning area that are listed as Threatened or Endangered under the Endangered Species Act or as sensitive by BLM Wyoming.

Table 3.36. Special Status Fish Species in the Planning Area

Common Name	Habitat	Status
Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*)	Relatively clear, cold creeks, rivers, and lakes at temperatures between 4 and 15 °C (approximately 32 and 59 °F).	BLM Wyoming-listed sensitive
Source: BLM 2010e Note: Species is not present in the planning area, but is present in habitat subject to hydrologic influence from actions in the planning area. BLM Bureau of Land Management °C degrees Celsius °F degrees Fahrenheit		

At present, the only special status fish species in the planning area is Yellowstone cutthroat trout, a BLM-listed sensitive species. The USFWS was petitioned in 1998 to list Yellowstone cutthroat trout under the Endangered Species Act, but determined in 2006 that listing was not warranted. Yellowstone cutthroat trout are very limited on BLM-administered land, with approximately 5 miles of stream from nine distinct stream segments on the Tongue River, Little Youngs Creek, Earley Creek, SR Creek, Ash Creek, South Fork of the Little Tongue River, Middle Fork of East Pass Creek, East Pass Creek, and Red Gulch Creek within the historic range of this trout species. The last four of those listed total approximately 1.6 miles of stream on BLM-administered land and are within the current occupied range (Bradshaw et al. 2008) of the Yellowstone cutthroat trout. Bradshaw et al. (2008) estimated 986 total stream miles in the Little Bighorn and Tongue river drainages were historically occupied. There are federal minerals under virtually all the current occupied range, with most of the surface administered by the Forest Service. In contrast to the Yellowstone cutthroat, most of the fish in the planning area are warm-water, prairie fishes that do not cohabitate with Yellowstone cutthroat.

Today, stocking is relatively minimal in the Little Bighorn River Basin. Several attempts have been made to establish wild Yellowstone cutthroat trout populations. Most attempts have involved stocking Yellowstone cutthroat trout in headwater streams where brook trout are less prevalent (WGFD 2000). The Little Bighorn River has been stocked with Yellowstone cutthroat trout since 1990 and Gold and Little Falls creeks have been stocked since 2000. Future stocking has been cancelled because electrofishing surveys have shown that Yellowstone cutthroat trout do not retain and establish viable populations in these creeks after stockings. There could be several plausible explanations, such as poor spawning and over-winter habitat, cold water, and perhaps most importantly, competition with non-native brook trout. It is assumed that high-gradient cold-water temperatures, interspecific competition with brook trout, and poor habitat are the major contributing factors.

While fisheries habitat condition in the planning area is a function of historic activities, the BLM actively manages fishery habitat to conserve listed species and the ecosystems on which they depend, and ensure that the actions requiring BLM authorization or approval are consistent with the conservation needs of special status species and do not contribute to the need to list special status species, either under the provisions of the Endangered Species Act, BLM Manual 6840 (BLM 2008c), or the BLM Wyoming Sensitive Species Policy and List (BLM 2002a). Activities and management challenges affecting special status species fish are similar to those discussed in the *Fish and Wildlife Resources – Fish* section of this chapter. Appendix K (p. 1749) lists Wyoming NSS 1 through 3 species, including potentially rare to common species with declining or vulnerable habitats.

3.4.8.4. Trends

Most of the trends that have affected other species of fish in the planning area have also affected special status species. These include, but are not limited to, the impacts of grazing practices and management, recreation, mineral development, drought, and degraded habitat conditions. See the *Fish and Wildlife Resources – Fish* section for additional information.

3.4.8.5. Key Features

Key features for special status fish species are the same as the key features for general fish species. See the *Fish and Wildlife Resources – Fish* section for additional information.

3.4.9. Special Status Species – Wildlife

3.4.9.1. Regional Context

For a discussion of the regional context for populations and habitat for all wildlife including special status wildlife species, see the *Fish and Wildlife Resources – Wildlife* section of this chapter. The regional context of Greater Sage-Grouse within the Western Association of Fish and Wildlife Agencies (WAFWA) Management Zone 1 (MZ1) follows.

Greater Sage-Grouse MZ1 lies east of the Rocky Mountains in southern Alberta, eastern Montana and Wyoming, and extreme western North and South Dakota. MZ1 represents the eastern extent of Greater Sage-Grouse range. The primary sagebrush species associated with Greater Sage-Grouse habitat in MZ1 is Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*). Overall shrub cover is less than 10% (State of Montana 2012). Perennial herbaceous components typically contribute greater than 25% vegetative cover and consist mostly of rhizomatous and bunch-form grasses, with a diversity of perennial forbs (State of Montana 2012). Land ownership throughout is predominantly private (61%) with 26% on BLM managed lands and 13% state or other federal ownership.

Greater Sage-Grouse populations have declined in portions of MZ1 through wholesale loss of habitat as well as direct impacts to birds through disturbance and direct mortality. The most pervasive and extensive change to the sagebrush ecosystems in MZ1 is the conversion of nearly 60% of native habitats to agriculture (Samson et al. 2004). The conversion was facilitated by the Homestead Act of 1862 in the United States and the Canada Dominion Act of 1872 (Knick 2011). Under the Homestead Act, nearly 1.5 million people acquired and plowed over 309,000 square miles, (800,000 km^2) of land, primarily in the Great Plains (Samson et al. 2004). The impacts of land conversion in the late 1800s and early 1900s were probably greatest for sagebrush habitats nearest perennial water sources.

Currently, native vegetation covers about 59% of MZ1. Much of the direct habitat loss from conversion to agriculture has occurred in the far northwestern and northeastern portions of MZ1 (Knick et al. 2011). Cropland currently covers nearly 19% of the MZ1 and 91% of the MZ1 is within 6.9 km of cropland (Knick et al. 2011). Recent interest in bio-fuel production and high prices for small grains has resulted in an increase in the conversion of native grasslands or lands formerly enrolled in the Conservation Reserve Program (CRP) to cropland, further emphasizing the importance of BLM-administered lands and associated private lands managed for grazing to maintain large blocks of native grassland and shrubland habitats.

Most sagebrush habitats in MZ1 are managed as grazing lands for domestic livestock. Livestock grazing can influence ecological pathways and persistence of native vegetation and wildlife (Bock et al. 1993). The effects of grazing on sagebrush habitats in this management zone are much different than effects noted in the Great Basin since the landscape throughout MZ1 is adapted to withstand grazing disturbance (Knick et al. 2011). Historically large numbers of bison (*Bison bison*) moved nomadically through the MZ1 in response to changes in vegetation associated with drought, past grazing, and fire. Bison were replaced with domestic livestock in the late 1800s. The intensity and duration of grazing increased as domestic livestock numbers and annual grazing pressure increased. The high intensity grazing probably increased the density and perhaps the distribution of sagebrush in MZ1 particularly in combination with a concurrent reduction in the amount of fire on the landscape. Grazing on public lands was unregulated until the passage of the Taylor Grazing Act in 1934. Since the passage of the Taylor Grazing Act, range conditions have improved due to improved grazing management practices and livestock operations related to decreased livestock numbers and the annual duration of grazing. In addition, the BLM has applied Standards for Rangeland Health since 1997 to enhance sustainable livestock grazing and wildlife habitat while protecting watersheds and riparian ecosystems. However, developments to facilitate grazing management often include elements detrimental to Greater Sage-Grouse. Perhaps the most pervasive change associated with grazing management in Greater Sage-Grouse habitats throughout MZ1 is the construction of fencing and water developments (Knick et al. 2011). Barbed wire fences contribute to direct mortality through fence collisions (Stevens et al. 2011) and water developments may contribute to increased occurrence of WNv in Greater Sage-Grouse (Walker and Naugle 2011). Water developments are particularly prevalent in the north central portion of MZ1. Additional habitat modifications associated with grazing management include mechanical and chemical treatments to increase grass production, often by removing sagebrush (Knick et al. 2011).

Other major land uses in MZ1 include energy development (primarily oil and gas development), and urbanization and infrastructure. Oil and gas development has occurred throughout MZ1, but is concentrated in the southern portions (Powder River Basin), the north (Bowdoin Field), and the south and east (Williston Basin). Oil and gas development includes direct loss of habitat from well pad and road construction as well as indirect disturbance effects from increased noise and vehicle traffic. Oil and gas developments directly impact Greater Sage-Grouse through avoidance of infrastructure, or when development affects survival or reproductive success. Indirect effects include changes to habitat quality, predator communities, or disease dynamics (Naugle et al. 2010). Currently nearly 16% of MZ1 is within 3 km of oil and gas wells, a distance where ecological effect is likely to occur (Knick et al. 2011).

Urbanization and infrastructure development in MZ1 has also impacted Greater Sage-Grouse habitat. Development at population centers and subdivisions or smaller ranchettes and associated buildings, roads, fences, and utility corridors has also contributed to habitat loss and fragmentation in portions of MZ1. Current estimates suggest about 16% of MZ1 is within 6.9 km of urban development, although MZ1 generally has lower population densities and lower rates of population increases compared to the other management zones (Knick et al. 2011). Infrastructure development effects to Greater Sage-Grouse habitats in MZ1 are primarily related to highways, roads, powerlines and communication towers, with nearly 92% of MZ1 within 6.9 km of a road, 32% within 6.9 km of a powerline, and 4% within 6.9 km of a communication tower (Knick et al. 2011). Increased recreation and OHV use on lands in MZ1 are also thought to impact Greater Sage-Grouse habitats, but have not been studied (Knick et al. 2011).

The cumulative and interactive impact of multiple disturbances and habitat loss has influenced the current distribution of Greater Sage-Grouse in MZ1. The cumulative extent of human caused changes, the human footprint, on Greater Sage-Grouse habitat in MZ1 one is highest at the northern edge of MZ1, but occurs throughout MZ1 (Leu and Hanser 2011). Population centers for Greater Sage-Grouse in MZ1 (Doherty et al. 2011) generally correspond to areas lacking a high human footprint and some of these areas have been designated as Core Population Area by state game agencies. Greater Sage-Grouse range in MZ1 is overall very similar to portions of the range where Greater Sage-Grouse have been extirpated (i.e. areas with high human footprints), mostly because of the abundance and distribution of sagebrush in MZ1 (Wisdom et al. 2011) suggesting that Greater Sage-Grouse in MZ1 are more vulnerable to declines than other portions of the Greater Sage-Grouse range. For additional information on the regional context of Greater Sage-Grouse within Wyoming and range-wide, see Wyoming Greater Sage-Grouse Step Down

Report (BLM 2013f) and Summary of Science, Activities, Programs and Policies that Influence the Rangewide Conservation of Greater Sage-Grouse (*Centrocercus urophasianus*) (Manier et al. 2013), commonly referred to as the Baseline Environmental Report. These reports document the existing conditions and trends of resources affecting Greater Sage-Grouse and their habitat in Wyoming and range-wide respectively; the reports also identify management indicators.

3.4.9.2. Indicators

For a discussion of indicators related to special status wildlife species, see the *Fish and Wildlife Resources – Wildlife* section of this chapter. Please refer to the Vegetation sections for descriptions of indicators of vegetation health for habitats comprised of Forests and Woodlands, Grasslands and Shrublands, and/or Riparian/Wetland communities. In addition, indicators for each species or species group are included where available/appropriate.

3.4.9.3. Current Condition

Numerous special status wildlife species are present or have available habitat in the planning area (see Table 3.37, “Special Status Wildlife in the Planning Area” (p. 362)), including, one species that is a candidate for federal listing as a Threatened species (Greater Sage-Grouse). The planning area also includes habitat for 21 other species listed as BLM Wyoming sensitive. Appendix K (p. 1749) lists wildlife species of special concern to other agencies and groups in the planning area.

Table 3.37. Special Status Wildlife in the Planning Area

Common Name	Habitat	Status
Upland Game		
Greater Sage-Grouse	Sagebrush habitats	Candidate for federal listing as a Threatened species
Birds of Prey		
Bald eagle	Near large lakes and rivers in forested habitat where adequate prey and old, large-diameter cottonwood or conifer trees are available for nesting	BLM Wyoming-listed sensitive
Ferruginous hawk	Arid and semi-arid grassland regions that is open, level, or rolling prairies; foothills or middle elevation plateaus largely devoid of trees, and cultivated shelterbelts or riparian corridors	BLM Wyoming-listed sensitive
Northern goshawk	Mature, high-elevation forests of Engelmann spruce, subalpine fir, and lodgepole pine interspersed with mature aspen stands; needs a home range of more than 2,500 acres	BLM Wyoming-listed sensitive
Peregrine falcon	Open habitats from open woodlands and forests to shrub-steppe, grasslands, marshes, and riparian habitats; nests on cliffs	BLM Wyoming-listed sensitive
Swainson’s hawk	Open grasslands, prairies, farmlands, and deserts that have some trees for nesting	BLM Wyoming-listed sensitive

Common Name	Habitat	Status
Western burrowing owl	Arid and semiarid environments, with well-drained, level to gently sloping areas characterized by sparse vegetation and bare ground; prefers open prairie, grassland, desert, and shrub-steppe habitats, and might also inhabit agricultural areas; depends on burrowing mammals, such as prairie dogs and ground squirrels	BLM Wyoming-listed sensitive
Migratory birds (excluding Birds of Prey)		
Baird’s sparrow	Native mixed-grass and fescue prairie	BLM Wyoming-listed sensitive
Brewer’s sparrow	Northern Rocky Mountains, including sagebrush and alpine meadows	BLM Wyoming-listed sensitive
Loggerhead shrike	Grasslands interspersed with scattered trees and shrubs that provide nesting and perching sites	BLM Wyoming-listed sensitive
Long-billed curlew	Plains, grasslands, and prairies; nests on the ground in habitat that usually includes grass fewer than 30 centimeters (approximately 12 inches) high; bare ground, shade, abundant invertebrate prey, and a minimum of suitable habitat	BLM Wyoming-listed sensitive
Mountain plover	Low, open habitats such as arid short-grass, and mixed-grass prairies dominated by blue grama and buffalograss with scattered clumps of cacti and forbs, and saltbush habitats of the shrub-steppe of central and western Wyoming	BLM Wyoming-listed sensitive
Sage sparrow	Sagebrush flats, alkaline flats with saltbush, and semi-desert shrublands in the lowlands	BLM Wyoming-listed sensitive
Sage thrasher	Open, shrub-steppe country dominated by sagebrush or bitterbrush, with native grasses intermixed; generally avoids cheatgrass-dominated landscapes	BLM Wyoming-listed sensitive
Trumpeter Swan	Foraging grounds during migration include wetlands, lakes, and reservoirs	BLM Wyoming-listed sensitive
White-faced ibis	Shallow lake waters, muddy ground of wet meadows, marshes, ponds, lakes, rivers, flooded fields, and estuaries	BLM Wyoming-listed sensitive
Yellow-billed cuckoo	Riparian obligate; prefers extensive areas of dense thickets and mature deciduous forests near water; requires low, dense, shrubby vegetation for nest sites	BLM Wyoming-listed sensitive
Mammals		
Black-footed ferret	Short-grass and mid-grass prairies in close association with prairie dog colonies	Federally listed Endangered
Black-tailed prairie dog	Dry, flat, open, shortgrass, and mixed-grass grasslands with low, relatively sparse vegetation, including areas overgrazed by cattle	BLM Wyoming-listed sensitive
Fringed myotis	Hot desert scrubland, grassland, xeric woodland, sage grass steppe, mesic old-growth forest, and multi-aged subalpine coniferous and mixed deciduous forest; xeric woodlands (oak and pinyon juniper)	BLM Wyoming-listed sensitive

Common Name	Habitat	Status
Long-eared myotis	Coniferous forests in mountain areas; roosts in small colonies in caves, buildings, and under tree bark	BLM Wyoming-listed sensitive
Spotted bat	Prominent rock features in extreme, low desert habitats to high-elevation forests	BLM Wyoming-listed sensitive
Swift fox	Grasslands, plains, and foothills in short-grass prairies and deserts	BLM Wyoming-listed sensitive
Townsend's big-eared bat	Mines, caves, and structures in woodlands and forests to elevations above 9,500 feet	BLM Wyoming-listed sensitive
Reptiles and Amphibians		
Columbia spotted frog	Subalpine forests, grasslands, and sagebrush habitats at elevations from 1,700 feet to 6,400 feet	BLM Wyoming-listed sensitive
Northern leopard frog	Permanent ponds, swamps, marshes, and slow-moving streams throughout forest, open, and urban areas; waterbodies with abundant aquatic vegetation.	BLM Wyoming-listed sensitive
Source: BLM 2010e BLM Bureau of Land Management		

Trophy Game

There are no special status trophy game species in the planning area.

Small game Mammals

There are no special status small game species in the planning area.

Migratory Game Birds

There are no special status migratory game bird species in the planning area.

Furbearers

There are no special status furbearer species in the planning area.

Predatory Animals

There are no special status predatory wildlife species in the planning area.

Upland Game Birds

Greater Sage-Grouse

Regional Context

The Greater Sage-Grouse is a sagebrush obligate species (Schroeder et al. 1999). It is present on the plains and foothills of the arid west and can be found in short-grass and mixed-grass prairies, sagebrush shrublands, other shrublands, wet meadows, and agricultural areas, always associated with substantial stands of sagebrush. In Wyoming, this species is present as a breeding resident in suitable habitats below 8,300 feet (Orabona et al. 2012). Unlike in many other western states, the current range of the Greater Sage-Grouse in the planning area has not substantially contracted from its historical extent (WGFD 2002). Although the range of this species is relatively unchanged, the population numbers have trended downward. This decrease has been associated with the disturbance, destruction, and fragmentation of suitable Greater Sage-Grouse habitats (Martin 1970; Braun et al. 1977; Swenson et al. 1987; WGFD 2008d; Oedekoven 2001), increased predation resulting from these habitat alterations, and more recently disease in particular WNv (Wesenberg et al. 2012).

The Powder River Basin is near the eastern edge of Greater Sage-Grouse range. Vegetation communities in the planning area are naturally patchy because they represent a transition between the intermountain basin sagebrush communities to the west and the prairie communities to the east. Sagebrush coverage within the Powder River Basin is estimated to be 35% with an average patch size less than 300 acres (Leu and Rowland 2005). The Powder River Basin patch size has decreased by more than 63% in the past forty years, from 820 acre patches and an overall coverage of 41% in 1964 (Leu and Rowland 2005).

In 2000, the Wyoming Sage-grouse Working Group was formed to develop a statewide strategy for Greater Sage-Grouse conservation. This group prepared the Wyoming Greater Sage-Grouse Conservation Plan (WSGWG 2003) to provide for coordinated management and direction across the state. In 2004, local Greater Sage-Grouse working groups were formed to develop and implement local conservation plans. The entire planning area is part of the Northeast Wyoming local working group, in which the BLM participates.

Indicators

Birds are the most monitored taxa in Wyoming. Key efforts include annual breeding bird surveys and strategies outlined in the Wyoming Bird Conservation Plan. Additionally, the WGFD is involved in a variety of single species monitoring efforts related to raptors, waterfowl, and a few upland birds. Greater Sage-Grouse leks are extensively monitored across the state, annually, coordinated by the WGFD. The lek monitoring effort helps to estimate population, and identify trends. Program adaptation occurs when new information or changing conditions trigger modification of individual actions to accomplish conservation goals or evaluation and adaptation of Wyoming CWCS (WGFD 2009b).

Current Conditions

In 2010, the USFWS determined that the Greater Sage-Grouse is warranted for federal listing across its range, but listing is precluded by other higher priority listing actions. In addition to being listed as a Wyoming BLM sensitive species, Greater Sage-Grouse are listed as a WGFD species of greatest conservation need, because populations are declining and they are experiencing ongoing habitat loss. The Wyoming Bird Conservation Plan rates them as a Level I species, indicating they are clearly in need of conservation action. They are also listed byUSFWS as a BCC for Region 17.

Males of this species perform an extravagant mating display in areas called leks. Male Greater Sage-Grouse, particularly juveniles, are known to attend several different leks in a single breeding season (Schroeder et al. 1999). The components of lek habitat are discussed below. There are 353 documented lek sites in the WGFD Sheridan Region, which approximates the planning area. Lek complexes are present in many locations and are defined as one or more leks within 0.5 to 2.0 miles of each other. Map 30 shows the distribution of known lek sites in the planning area.

Seasonal range use and movements of Greater Sage-Grouse vary considerably between populations, with movements in some populations exceeding 45 miles (Connelly et al 1988). Depending on the migratory nature of the population, these ranges can overlap or be geographically distinct (Connelly et al. 2000). Within the overall range of a population, a series of habitats are used during the year. The spatial arrangement of leks, their relative availability, and the condition of vegetation in leks all affect the potential of these habitats to support Greater Sage-Grouse. The following six seasonal habitats have been defined for Greater Sage-Grouse in Wyoming (WGFD 2002), each of which has components important for Greater Sage-Grouse reproduction and survival:

- Winter Habitat: Greater Sage-Grouse feed almost exclusively on sagebrush during winter. Winter habitats generally contain a canopy cover of 15% or greater of taller sagebrush and are in areas where snow depths do not restrict access to sagebrush, such as south-facing slopes and windswept areas (Connelly et al. 2000; WGFD 2002).
- Breeding Habitat (Leks) – Early Spring: Greater Sage-Grouse use leks from late March through April and the leks generally are in open areas such as broad ridges, grassy areas, and disturbed sites (WGFD 2002). Greater Sage-Grouse select sites with less sagebrush and other shrub cover than the surrounding landscape, although these sites are often surrounded by sagebrush that females attending the lek and non-displaying males use as cover and for foraging (Schroeder et al. 1999). Habitats that surround the lek site also are important because they provide the forage hens need to produce eggs and are often used for nesting (Braun et al. 1977); however, migratory populations are much less centered around lek sites than nonmigratory populations (Connelly et al. 2000).
- Nesting Habitat – Late Spring: Nests are generally placed under sagebrush, but other large shrubs can be used (WGFD 2002). Greater Sage-Grouse select nest sites with higher than average canopy cover of sagebrush and herbaceous plant density, which leads to increased nest success (Connelly et al. 2000).
- Early Brood-Rearing Habitat – June to Mid July: This habitat is used during the first month of the brood's life (WGFD 2002). The brood is moved from the nest site immediately after it hatches and can move up to 5 miles in the first 10 days. This habitat generally has a higher herbaceous cover because brood survival is closely related to the availability of forbs and insects, which are the most important part of chick diets (Schroeder et al. 1999).
- Late Brood-Rearing Habitat – Mid July through Mid September: During this period, many upland forbs have dried up and Greater Sage-Grouse typically move to wetter locations, such as higher elevations or riparian areas (WGFD 2002). Broods tend to move to sites with higher than average forb cover and will focus on relatively small areas if the necessary forage is available (Connelly et al. 2000).
- Fall Habitat — Mid September to First Major Snow: Movement to, and use of, fall habitat is variable, depending on the weather and condition of forage. In Wyoming, this habitat is typically used from mid September until the first major snow (WGFD 2002). During this period, Greater Sage-Grouse shift from feeding mostly on forbs to relying heavily on sagebrush as frost causes forbs to become dormant (Connelly et al. 2000).

Based on the distribution of sagebrush, Greater Sage-Grouse are present in much of the planning area throughout the year. Populations in the planning area are both nonmigratory, exhibiting minimal migratory behavior, moving locally to different food resources or to escape deep snow, and migratory, moving several miles to different food resources or to escape deep snow.

As a result of past and ongoing human activities in the planning area, substantial areas of Greater Sage-Grouse habitats have been altered from their natural conditions. For example, 46% (3,386,530 acres) of the planning area is BLM-administered fluid mineral estate of which 75% (2,544,512 acres) has been leased (Map 12); the majority of which has been developed and is held by production. Much of the non-federal minerals have also been developed as the pattern is to develop the non-federal minerals prior to the federal minerals. Human disturbances include, but are not limited to, agriculture, mining, roads, urban areas, oil and gas well pads, compressor sites, and other ancillary facilities. Changes in land use and land development are the primary causes of habitat loss, while habitat degradation is a complicated interaction among many factors, including drought, livestock grazing, changes in natural fire regimes, and invasive plant species (Fischer et al. 1996; Pyle and Crawford 1996; Beck and Mitchell 2000; Nelle et al. 2000). Emerging issues include the impacts of pesticides, disease, noise, and raptor perch sites on powerlines among Greater Sage-Grouse populations.

Energy development within two miles of leks is projected to reduce the average probability of lek persistence from 87% to 5% (Walker et al. 2007a). Current research suggests that impacts to leks from energy development are discernible out to a minimum of 4 miles, and that some leks within this radius have been extirpated as a direct result of energy development (Apa et al. 2008). Even with a timing limitation on construction activities, Greater Sage-Grouse avoid nesting in oil and gas fields because of the activities associated with operations and production.

Another concern for Greater Sage-Grouse populations is that reservoirs created for disposal of CBNG produced water provide habitat for mosquitoes that carry WNv (Thiele 2005). WNv represents an important new stressor, which in 2003 reduced late summer survival of Greater Sage-Grouse an average of 25% within four populations, including the Powder River Basin population (Naugle et al. 2004) and in an outbreak year can more than cut a population in half (Taylor et al. 2012). In northeastern Wyoming and southeastern Montana, WNv-related mortality during summer resulted in an average decline in annual female survival of five percent from 2003 to 2006 (Walker et al. 2007a). Greater Sage-Grouse losses in the planning area during 2004 and 2005 were not as severe. Summer 2003 was warm and dry, more conducive to WNv replication and transmission than the cooler summers of 2004 and 2005 (Cornish 2005). Current science suggests a synergy between WNv and energy development that amplifies the negative impact to Greater Sage-Grouse (USFWS 2010). Additional information on the threat of WNv to Greater Sage-Grouse can be found in Appendix D (p. 1603).

Greater Sage-Grouse avoidance of oil and gas infrastructure results in even greater indirect habitat loss. Doherty et al. (2008) demonstrated that Greater Sage-Grouse in the Powder River Basin avoided otherwise suitable wintering habitats once they have been developed for energy production, even after timing and lek buffer stipulations had been applied. Research indicates that oil or gas development exceeding approximately one well pad and its associated infrastructure per square mile results in calculable impacts to breeding populations, as measured by the number of male Greater Sage-Grouse attending leks (Holloran 2005; Walker et al. 2007a). The WGFD recommends avoiding a well density greater than three or greater than 60 acres of disturbance per square mile (WGFD 2009b).

Current management of Greater Sage-Grouse focuses primarily on the protection of Greater Sage-Grouse breeding and nesting habitats. Current management restricts surface disturbance and occupancy within 0.25 mile of occupied Greater Sage-Grouse leks. Current management also restricts surface-disturbing and disruptive activities in suitable Greater Sage-Grouse nesting habitats within two miles of an occupied lek from March 15 to June 15, unless site-specific circumstances warrant greater protections.

Based on research conducted by Holloran et al. (2005) and Moynahan et al. (2004), a two-mile timing limitation, given the long-term population decline and the fact that fewer than 50% of Greater Sage-Grouse are expected to nest in the protected area, is insufficient to reverse the population decline. The end result is that the Wyoming Powder River Basin population supports a small remaining Greater Sage-Grouse population that has experienced an 82% decline within the expansive energy fields (Walker et al. 2007a). Moynahan et al. (2004), like the Western Association of Fish and Wildlife Agencies (Connelly et al. 2000), recommend increasing the protective distance around Greater Sage-Grouse leks. Walker et al. (2007a) indicates the size of a no-development buffer sufficient to protect leks would depend on the amount of suitable habitat around the lek and the impact to population deemed acceptable. Research suggests additional more effective mitigation strategies include, at a minimum: burying powerlines (Connelly et al. 2000); minimizing road and well pad construction, vehicle traffic, and industrial noise (Lyon and Anderson 2003; Holloran et al. 2005); and managing produced water to prevent the spread of mosquitoes with the potential to vector WNv in Greater Sage-Grouse habitat (Walker et al. 2007a).

In response, Governor Frudenthal issued an Executive Order on August 1, 2008, mandating special management for all state lands in Greater Sage-Grouse "Core Population Areas." Core Population Areas are important breeding areas for Greater Sage-Grouse in Wyoming. In addition to identifying Core Population Areas, the Sage-Grouse Implementation team recommended placing stipulations on development activities to ensure that existing habitat function is maintained within the Core Population Areas. Accordingly, the Executive Order prescribes special consideration for Greater Sage-Grouse, including authorization of new activities only when the project proponent can identify that the activity will not cause declines in Greater Sage-Grouse populations in the Core Population Areas. These protections would apply to approximately 80% of the total estimated Greater Sage-Grouse breeding population in the state. In February 2010, the Wyoming State Legislature adopted a joint resolution endorsing Wyoming's Core Population Area Strategy as outlined in the Governor of Wyoming's Executive Order 2008-2. BLM Wyoming has adopted Wyoming's approach for projects under its authority, which was updated in three subsequent executive orders in 2010, 2011, and 2013, EO 2010-4, EO 2011-5, and EO 2013-3, respectively.

By 2008, the Powder River Basin had already experienced a level of impact that severely reduced options for delineating Core Population Areas that would be large enough and in high enough quality habitats to sustain populations (Taylor et al. 2012). Wyoming's core population area policy will be most effective where implemented in advance of extensive energy development, and in southwest portions of the state where high elevation populations are less susceptible to WNv impacts. In northeast Wyoming, WNv outbreak years are the wild card in Core Population Area management. One of the programs the BLM has initiated to improve the situation, is that the BLM's High Plains District founded the Powder River Basin Restoration program, a partnership which promotes reclamation practices and habitat enhancement projects aimed at restoration of sagebrush habitats for the Greater Sage-Grouse.

While the Powder River Basin Greater Sage-Grouse population is a population at risk of extirpation, the Wyoming Basin population is at low risk, as the state designated Core Population Areas adequately capture redundancy and representation for this large population (USFWS 2013a). The USFWS views Wyoming's Core Population Area Strategy as a sound policy and an adequate mechanism to preclude the need to list Greater Sage-Grouse (USFWS 2011). The Core Population Area Strategy is being analyzed within Alternative D of this document.

Trends

WGFD relied on lek data as the basis for analyzing trends in the population of Greater Sage-Grouse. The number of active leks and lek complexes has varied over the past 10 years, as has the estimated population. The Greater Sage-Grouse population in northeast Wyoming is exhibiting a steady long-term downward trend (WGFD 2009b). Absent a WNv outbreak year, the lower 95% confidence limit on the population count is 3,147 males, suggesting that immediate extirpation of the northeast Wyoming population is unlikely if all environmental conditions for Greater Sage-Grouse other than energy development, remain favorable. CBNG activity has waned in recent years with the decline in natural gas prices. To date development is approximately half that predicted in the PRB FEIS (BLM 2003c). Additional information on the existing conditions and trends of resources affecting Greater Sage-Grouse within Wyoming and range wide are identified in the Wyoming Greater Sage-Grouse Step Down Report (BLM 2013f) and Summary of Science, Activities, Programs, and Policies that Influence the Rangewide Conservation of Greater Sage-Grouse (*Centrocerus urophasianus*) (Manier et al. 2013) commonly referred to as the Baseline Environmental Report. The Baseline Environmental Report is anticipated to be publicly available in May 2013.

Non-Game Species

Birds of Prey

Indicators

Birds are the most monitored taxa in Wyoming. Key efforts include annual breeding bird surveys and strategies outlined in the Wyoming Bird Conservation Plan. Additionally, the WGFD is involved in a variety of single species monitoring efforts related to raptors, waterfowl, and a few upland birds. Program adaptation occurs when new information or changing conditions trigger modification of individual actions to accomplish conservation goals or evaluation and adaptation of Wyoming CWCS (WGFD 2009b).

Current Conditions

Six special status raptor species are present in the planning area (Table 3.37, “Special Status Wildlife in the Planning Area” (p. 362)); all are BLM-listed sensitive species. The USFWS Wyoming Ecological Field Office *Raptor Guidelines* (USFWS 2013b) summarizes the typical nesting periods for these and other raptor species.

Current management establishes a buffer zone around raptor nest sites that considers topography and special status prey habitats surrounding the nest site. Except for bald eagles, buffer zones around nests also include a 0.5-mile seasonal restriction (timing limitation stipulation) for activities from February 1 through July 31. The bald eagle timing limitation is discussed below.

Management challenges for special status raptor species include habitat degradation, fragmentation, and loss; lack of cottonwood and aspen regeneration; collision and electrocution from powerlines; collision with wind turbines; and incompatible land use practices (e.g., land conversion, clear cutting, snag removal, industrial activities, intensive recreational activities, and removal of burrowing mammals). Other challenges include impacts from contaminants and human disturbance during sensitive periods (Cerovski et al. 2001; Barrett 1998b; Jones 1998a; Preston 1998a; WGFD 2009b).

Management actions focus on maintaining the presence of special status raptor species and the habitats upon which they depend in the planning area. Seasonal and spatial protective stipulations are currently applied around identified nest sites and roost areas (bald eagle) to afford raptors a level of protection from human disturbance and industrial activities.

Bald Eagle

Regional Context

Bald eagles are present throughout North America from Alaska to Newfoundland, and from the southern tip of Florida to southern California. In Wyoming, this species builds large nests in the crowns of large mature trees such as cottonwoods or pines. The availability of food is likely the single most important determining factor for distribution and abundance of bald eagles. Fish and waterfowl are the primary sources of food where eagles are present along rivers and lakes. Big game and livestock carrion, waterfowl and large rodents such as prairie dogs also can be important dietary components where these resources are available (Ehrlich et al. 1988). The bald eagle is an uncommon breeding resident in Wyoming, using mixed coniferous and mature cottonwood-riparian areas near large lakes or rivers as nesting habitat (Orabona et al. 2012).

Current Conditions

The bald eagle was listed as Endangered on February 14, 1978, in all of the conterminous United States except Minnesota, Wisconsin, Michigan, Oregon, and Washington, where it was classified as Threatened (USFWS 1978). On July 12, 1995, the USFWS reclassified the bald eagle from Endangered to Threatened throughout its range in the lower 48 states (USFWS 1995). On August 8, 2007, the bald eagle was removed from the Endangered species list. The bald eagle remains under the protection of the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act, and now carries status as a BLM Wyoming sensitive species.

In Wyoming, the availability of carrion, including big game and livestock, is an important winter food source for wintering bald eagles. Eagles winter throughout the planning area. Feeding areas, diurnal perches, and night roosts are fundamental elements of bald eagle winter habitat. Although eagles fly as far as 15 miles (24 kilometers) to and from these elements, they are present primarily where all three elements are available comparatively close (Swisher 1974).

This species is a documented breeder and winter resident of the planning area (Orabona et al. 2012). Map 34 shows documented bald eagle nests in the planning area. The bald eagle population in the planning area increases during winter when seasonal migrants and year-round residents share roost sites and foraging areas.

Human activity and development (residential and recreational) near rivers and lakes continues to escalate and is degrading bald eagle habitat. Pioneering pairs of bald eagles often have difficulty establishing nesting territories that are disjunct from other nesting pairs. Bald eagles are still accumulating organochlorines and relatively high levels of heavy metals, and could also be at risk from organophosphate or carbamate pesticides (WGFD 2010). These contaminants could affect production and survival.

Different from the management of all other raptor species, current management of bald eagle habitats consist of a disturbance-free buffer zone of 0.5 mile (NSO) established year round for all bald eagle nest sites. A seasonal disturbance-free buffer zone of 1 mile is established for all bald eagle nest sites (February 15 to August 15). A seasonal disturbance-free buffer zone of 0.5 mile is established for all bald eagle winter roost sites (November 1 to April 1). These buffer zones and timing can be adjusted based on site-specific information through coordination with, and written approval from, the USFWS.

Trends

Data from the North American Breeding Bird Survey (BBS) Trend Analysis (Sauer et al. 2012) indicate a positive trend for populations of this species in Wyoming during the period 1966 to 2011. The trend for the United States during the same period is positive.

Ferruginous Hawk

Regional Context

The ferruginous hawk is an uncommon occupant of grasslands, sagebrush, and desert scrub habitats in the Great Plains and Great Basin regions. On the Great Plains, breeding pairs are normally associated with native grasslands (Gilmer and Stewart 1983). The BLM Wyoming considers it a sensitive species. In Wyoming, this species is a common breeding resident, occupying basin-prairie shrublands, short-grass prairie, rocky outcrops, and cottonwood-riparian habitats (Orabona et al. 2012). This hawk will nest in trees and similar structures when available, but also will readily nest on the ground (Preston 1998a). Nest sites include cliff faces, rocky outcrops, grassy knolls, promontories, tall sagebrush, or in junipers where numerous small mammals provide abundant prey base (Orabona et al. 2012). This hawk preys almost exclusively on small to medium-sized mammals, including jackrabbits, cottontails, prairie dogs, and ground squirrels (Preston 1998a). The ferruginous hawk is known to nest in suitable habitats throughout Wyoming and has been documented in the planning area. Wyoming has one of the largest breeding populations of ferruginous hawks when compared to any other state or province and is also the approximate center of the species breeding range. Estimates have been made indicating that there may be more than 800 pairs of ferruginous hawks within Wyoming.

Current Conditions

The USFWS Birds of Conservation Concern (BCC) (USFWS 2008b) report identifies the ferruginous hawk as a “species, subspecies, and population of migratory bird that without conservation actions is likely to become a candidate for listing under the Endangered Species Act.” The Wyoming Partners in Flight Wyoming Bird Conservation Plan identifies the ferruginous hawk as a “Conservation Priority Level 1 (Conservation Action).” WGFD lists the ferruginous hawk as an NSS3, indicating a restricted or declining population with extirpation possible, but not necessarily imminent. This designation generally recognizes suitable habitat as vulnerable to ongoing disturbance and loss.

Threats attributed to decline in ferruginous hawk populations range-wide may be attributed to habitat loss and degradation. Other major threats include control of prey populations via means of shooting and chemical poisoning of varmints and small mammals. Large declines in occupied prairie dog habitat have also occurred throughout every state in Region 2. Another key player is energy and mining development activities which are believed to threaten ferruginous hawks via means of disturbance, habitat alternation or loss, and reduction or loss of prey populations. The development of CBNG reserves throughout Wyoming and Colorado is relatively recent. These new developments will potentially affect a large portion of the range of ferruginous hawks in these areas. These threats include but are not limited to: increased habitat fragmentation, increased human disturbance during the reproductive period, potential changes in the abundance and diversity of primary prey species, increased exotic vegetation establishment in newly disturbed areas, increased risk of electrocution of ferruginous hawks due to additional overhead power, and increased risk of collisions with vehicles and high tension wires. This threat should be considered serious and will likely persist for many decades. Also the conversion of native shrub-steppe habitats to non-native annual grasslands through altered fire regimes is a serious threat to ferruginous hawks in the Intermountain West, and areas of the Region 2 such as Wyoming that contain large expanses of sagebrush (Collins and Reynolds 2005).

Trends

Data from the North American BBSTrend Analysis (Sauer et al. 2012) indicate a minor positive trend for populations of this species in Wyoming during the period 1966 to 2011. The overall trend for the United States during the same period is positive. Range-wide population data available for this species is limited, and it is declining in portions of its range. Population trends in certain parts of the ferruginous hawk's range are attributed to concomitant fluctuations in the available prey base, suggesting the plasticity of the species to adapt to variation within prey populations. Variation in ferruginous hawk annual breeding numbers range-wide and in Region 2 is primarily influenced by changes in prey abundance, while annual variation in winter abundance is primarily related to winter severity and prey abundance. As a result, during more arduous winters ferruginous hawk numbers may be drastically reduced in Wyoming and South Dakota (Collins and Reynolds 2005).

Northern Goshawk

Regional Context

The northern goshawk is a common resident in Wyoming and BLM Wyoming considers it a sensitive species. This species is known to occur from Alaska through the Rocky Mountains to New Mexico and in the mountains and forests of Washington, Oregon, and interior California (Udvardy 1977). Goshawks typically prey on squirrels, ducks, and other birds. They often forage throughout the forest, including in aspen stands, meadows, and forest openings. The northern goshawk is a documented breeding resident of Wyoming (Orabona et al. 2012). Northern goshawks nest in a variety of habitats, including conifer and aspen forests, and occasionally cottonwood trees (Barrett 1998b). Several northern goshawk nest sites have been documented in the planning area.

Current Conditions

Incompatible forest management techniques could remove suitable nest stands and degrade habitat by reducing stand density and canopy cover. Fire suppression, catastrophic fires, loss of vegetative cover, and outbreaks of insects and tree diseases can result in the deterioration or loss of nesting habitat. Human disturbances (such as forest management) can cause nest abandonment.

Trends

The population status and trends of northern goshawks in Wyoming are largely unknown; however, data from the BBS Trend Analysis (Sauer et al. 2012) indicate a minor positive trend for populations of this species in Wyoming between 1966 and 2011. For the same period across all BBS routes in the United States, the population trend was minor and negative.

Peregrine Falcon

Regional Context

A mid- to large-sized falcon, this species occurs across North America and uses a variety of habitats. The peregrine falcon is typically associated with open country near rivers, marshes, and coasts. Cliffs are preferred nesting substrate; however, they might also use tall fabricated structures. Peregrine falcons typically prey on birds such as waterfowl, shorebirds, grouse, and pigeons. In Wyoming, this species is a rare resident, with most breeding records from the western portion of the state (Orabona et al. 2012).

Current Conditions

Widespread use of pesticides, especially DDT, caused extensive eggshell thinning and reproductive failure. By the late 1970s, there were no viable breeding populations in Wyoming. In 1972, federal legislation limited the use of many pesticides, including DDT, and in 1980 the WGFD formed a partnership with The Peregrine Fund, Inc., and began a 15-year cooperative reintroduction effort. Since 1984, Wyoming's nesting population of peregrine falcons has increased by about 35% every year, and more than 60 pairs nested in the state in 2002. The development and use of new chemicals, along with growing pollution, could increase environmental contamination and again threaten production and nesting populations.

Increasing numbers and distribution of peregrine falcons in Wyoming mean a dramatic increase in survey efforts to continue adequate documentation of the population increase, but funding is increasingly inadequate to monitor peregrine falcon populations. The peregrine falcon was removed from the federal list of Endangered species in 1999 (USFWS 1999). BLM Wyoming now considers it a sensitive species. This species nests in the Big Horn Mountain portion of the planning area, but has not been observed on BLM-administered surface.

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate positive trends in population change for this species in USFWS Region 6, which includes Wyoming, and the United States between 1966 and 2011.

Western Burrowing Owl

Regional Context

The western burrowing owl, a BLM Wyoming sensitive species, occurs from south-central British Columbia eastward to southern Saskatchewan and south through most of the western United States. Burrowing owls primarily nest in rodent burrows, particularly prairie dog burrows, in grasslands, shrublands, deserts, and grassy urban settings (Jones 1998a). In Wyoming, this species uses grasslands, sagebrush and other shrublands, and agricultural areas. Burrowing owls typically feed on insects, rodents, lizards, and small birds. This species is a confirmed breeder throughout much of the state (Orabona et al. 2012). Populations of this species can vary considerably in the planning area, influenced by fluctuations in availability of prey. This species is present as a summer resident, nesting in suitable habitats in the planning area.

Current Conditions

The dramatic reduction of prairie habitat in the United States has been linked to reduction of burrowing owl populations (Klute et al. 2003). Use of roads and pipeline corridors associated with CBNG development increases owl vulnerability to vehicle collision. Overhead powerlines provide perch sites for larger raptors, which prey upon burrowing owls. CBNG infrastructure such as roads, pipeline corridors, and nearby metering facilities also provide shelter and den sites for ground predators such as skunks and foxes. The western burrowing owl is relatively tolerant of human activity, often to its detriment. Threats across the North American range of the burrowing owl are habitat loss and fragmentation, primarily due to intensive agricultural and urban development, and habitat degradation due to declines in populations of colonial burrowing mammals (Klute et al. 2003). It is listed as a sensitive species by the BLM throughout the west.

Different from the management of all other owl species, current management of western burrowing owl nests consists of a 0.25-mile timing restriction buffer zone for burrowing owl nest locations during their nesting season (April 15 to August 31).

Trends

The current population of the western burrowing owl in the United States is not well known, but trend data suggest material declines (McDonald et al. 2004). Data from the North American BBSTrend Analysis (Sauer et al. 2012) indicate a minor positive trend for populations of this species in Wyoming during the period 1966 to 2011. The overall trend for the United States during the same period, however, is negative. The last official population estimate placed them at fewer than 10,000 breeding pairs. Most of the states in the owl's range have recognized that western burrowing owl populations are declining.

Migratory Birds (Excluding Birds of Prey)

Ten special status migratory birds are known or suspected to be present within the planning area (Table 3.37, "Special Status Wildlife in the Planning Area" (p. 362)). Regional context is provided for each special status migratory bird species.

Indicators

In cooperation with the USFWS, the Migratory Game Bird Section of the WGFD remains strongly involved in the Central and Pacific Flyway management efforts, including development and revision of management plan for various migratory game bird populations and annual season setting (Roberts and Bohne 2010).

Current Conditions

Threats to migratory birds include habitat fragmentation and degradation, land conversion, incompatible land uses (e.g., industrial activities, human disturbance, contaminants, and agricultural practices), water quantity and quality, lack of cottonwood regeneration, snag removal in preferred habitats, collision with wind turbines and powerlines, and interspecific competition for nest sites.

Management actions focus on maintaining or increasing the viability and biological integrity of special status species' foraging and nesting habitats in the planning area.

Trends

Species widely distributed in Wyoming are believed to have relatively stable population trends in the planning area; however, there are no population trend data for species that exhibit a more restricted distribution. Results and analyses of 1966 to 2011 data for the North American BBS provide more information on trends (Sauer et al. 2005). Collectively, these species occupy all vegetative types in the planning area and are all seasonal migrants.

Baird's Sparrow

Regional Context

Baird's sparrow, a BLM Wyoming-listed sensitive species, ranges from Alberta, Saskatchewan, Manitoba, and Montana to South Dakota (Udvardy 1977).

Current Conditions

In Wyoming, this species is an uncommon summer resident that uses short-grass prairie habitats (Orabona et al. 2012). The typical diet for this species consists of seeds and insects. This species can be present in suitable habitats in the planning area; however, no nests have been documented due to a lack of surveying effort.

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate negative trends in population change for this species in USFWS Region 6, which includes Wyoming, and the United States between 1966 and 2011.

Brewer's Sparrow

Regional Context

Brewer's sparrow, a BLM Wyoming-listed sensitive species, ranges from British Columbia east to Saskatchewan, south to New Mexico, Arizona, and southern California (Udvardy 1977).

Current Conditions

In Wyoming, this species is a common summer resident occupying sagebrush shrubland and other shrubland habitats throughout the state (Orabona et al. 2012). Brewer's sparrow typically feed on insects and seeds. This species is present in suitable habitats in the planning area.

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate a minor negative trend for populations of this species in Wyoming between 1966 and 2011. For the same period across all BBS routes in the United States, the population trend was negative.

Loggerhead Shrike

Regional Context

Loggerhead shrike, a BLM Wyoming-listed sensitive species, occurs from North America, south of the coniferous forest region into Mexico (Udvardy 1977). The loggerhead shrike is typically associated with open vegetative types, including agricultural areas, sagebrush shrublands, desert scrub, pinyon-juniper woodlands, and montane meadows (BLM 2003c).

Current Conditions

In Wyoming, this species is a common summer resident, using pine-juniper, woodlands, short- and mixed-grass prairies, and shrublands. Loggerhead shrikes typically feed on grasshoppers, crickets, other insects, mice, and small birds. This species is known to breed throughout Wyoming (Orabona et al. 2012) and is present in the planning area.

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate a negative trend for populations of this species in Wyoming between 1966 and 2011. For the same period across all BBS routes in the United States, the population trend was negative.

Long-billed Curlew

Regional Context

Long-billed curlew, a BLM Wyoming-listed sensitive species, occurs from southern British Columbia to Manitoba, southeast to Wisconsin, Illinois, and Kansas, and south to northern California and northern Texas (Nelson 1998). The long-billed curlew nests on short-grass prairies and feeds on insects and aquatic invertebrates in salt marshes, mud flats, and beaches (Udvardy 1977).

Current Conditions

In Wyoming, suitable habitat can include sagebrush shrublands, wet meadows, irrigated meadows, and agricultural areas (Orabona et al. 2012). This species is a common summer breeding resident throughout much of central and western Wyoming. In the planning area, breeding curlews have been reported from Johnson County (Orabona et al. 2012).

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate a minor positive trend in population change for this species in Wyoming between 1966 and 2011. During the same period across all BBS survey routes in the United States, the trend was minor and positive.

Mountain Plover

Regional Context

Mountain plovers once occupied suitable breeding habitats in many of the Great Plains states form Canada to Texas, but their breeding range is now restricted to extreme southern Alberta, Canada, portions of Montana and Wyoming, eastern Colorado, northern and eastern New Mexico, northeastern Utah, and the western panhandle of Oklahoma and Texas. There are a few records of breeding activity in extreme western Kansas and Nebraska and in northeastern Arizona. Wintering mountain plovers are typically concentrated in the Central Valley of California, Texas, and Mexico. Arizona and New Mexico also support lower densities of wintering mountain plovers (BLM 2007k).

Current Conditions

This species uses high, dry, short-grass prairie with vegetation typically shorter than 4 inches. Within this habitat, the mountain plover most often uses areas of blue grama and buffalograss, as well as areas of mixed-grass associations dominated by needle and thread and blue grama (Dinsmore 2003). Nests consist of a small scrape on flat ground in open areas. Most nests are placed in April on slopes of less than 5 degrees in areas where vegetation is shorter than 3 inches. More than half identified nests were within 12 inches of old cow manure piles and almost 20% were against old manure piles in similar habitats in Colorado. Nests in similar habitats in Montana (Dinsmore 2003) and other areas (Ehrlich et al. 1988) were almost always associated with the heavily grazed short-grass vegetation of prairie dog colonies.

Mountain plovers arrive on their breeding grounds in late March and begin laying eggs in late April. Clutches are hatched by late June, and chicks fledge by late July. The fall migration begins in late August, and most birds are gone from the breeding grounds by late September. In Wyoming, this species is a common breeding resident (Orabona et al. 2012) and is expected to be present in suitable habitats in the planning area. Data compiled by the Buffalo Field Office indicate that mountain plover nesting occurs sporadically throughout the planning area, including in northeastern Converse County near Gillette, and in Sheridan County. Records of mountain plover observations in the Wyoming Natural Diversity Database include sightings near Buffalo and Gillette and in the Thunder Basin National Grassland. Kenaith et al. (2001) characterized mountain plover habitat in the planning area as sparse and fragmented.

In 2003, the USFWS withdrew its proposal to list the mountain plover as Threatened, but reinstated it again in 2010. On May 11, 2011, the USFWS, once again, withdrew their proposed listing of the mountain plover as a Threatened species. Currently, the mountain plover is listed in Wyoming as a BLM sensitive species. Mountain plover is a WGFD Species of Greatest Conservation Need (SGCN), because population status and trends are unknown but are suspected to be stable, habitat is vulnerable without ongoing substantial loss, and the species is sensitive to human disturbance. The Wyoming Bird Conservation Plan rates them as a species with highest conservation priority, indicating they are clearly in need of conservation action. They are also listed by USFWS as a Bird of Conservation Concern (BCC) for Region 17, which includes the project area. BCCs are those species that represent USFWS's highest conservation priorities, outside of those that are already listed under ESA. The goal of identifying BCCs is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions. Mountain plovers are considered an uncommon nester in the planning area.

Current management of mountain plovers includes:

- A mountain plover nesting survey is required in suitable habitat before commencing surface-disturbing activities.
- No surface-disturbing activities are allowed in suitable habitat from March 15 to July 31 unless there has been a mountain plover nesting survey during the current breeding season.
- There is a seasonal disturbance-free buffer of 0.25 mile around occupied mountain plover nesting locations between March 15 and July 31.
- Documented nesting areas are surveyed for 5 years following project completion.
- Maximum allowed travel speed on roads within 0.5 mile of identified mountain plover nesting areas do not exceed 25 miles per hour from March 15 to July 31.
- No dogs are permitted at worksites to reduce the potential for harassment of mountain plovers.

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate a negative trend for populations of mountain plovers in Wyoming and along all survey routes in the United States between 1966 and 2011 (Map 35).

Sage Sparrow

Regional Context

The sage sparrow, a BLM Wyoming-listed sensitive species, occurs from Washington south to Baja California and throughout the Great Basin (Udvardy 1977).

Current Conditions

The sage sparrow is a common summer resident in the Wyoming grasslands and shrublands, typically feeding on insects and seeds (Orabona et al. 2012). This species is present in the planning area.

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate positive changes for populations of this species in Wyoming between 1966 and 2011. For the same period across all BBS routes in the United States, the population trend was minor and negative.

Sage Thrasher

Regional Context

The sage thrasher, a BLM Wyoming-listed sensitive species, occurs from south-central British Columbia to southern Nevada, Utah, through Texas and Oklahoma, and in the San Joaquin Valley of California (Udvardy 1977).

Current Conditions

In Wyoming, this species is a common summer resident, breeding in sagebrush shrublands throughout the state (Orabona et al. 2012). Sage thrashers typically feed on insects and some fruit. This species is present in suitable habitats in the planning area.

Trends

Data from the BBS Trend Analysis (Sauer et al. 2012) indicate a minor positive trend for populations of this species in Wyoming between 1966 and 2011. For the same period across all BBS routes in the United States, the population trend was minor and negative.

Trumpeter Swan

Regional Context

The trumpeter swan breeds in southern Alaska, northern British Columbia, western Alberta, Oregon, Idaho, Montana, and Wyoming.

Current Conditions

BLM Wyoming considers the trumpeter swan a sensitive species because breeding populations are restricted in numbers and distribution, there is ongoing material loss of nesting habitat, and it is sensitive to human disturbance. Trumpeter swans typically feed on aquatic vegetation, aquatic invertebrates, and insects. As a result of habitat destruction and over hunting, this species was close to extinction, but careful management and reintroduction practices have helped return the population to several thousand individuals (Udvardy 1977). This species is an occasional migrant that nests on muskrat houses or small islands in open water; however, there are no breeding populations in the planning area. Suitable habitats for this species include lakes and ponds with developed aquatic vegetation for feeding and nesting materials (BLM 2003c). This species has been observed throughout the state, including the planning area (Orabona et al. 2012).

Trends

The BBS Trend Analysis (Sauer et al. 2012) did not include population trend data for this species. The USFWS coordinates surveys for breeding swans in the United State, including Wyoming. Overall trends from the surveys for 1993 – 2011 are minor negative for Wyoming, and positive in the overall population that breeds in the United States (Olson 2012).

White-faced Ibis

Regional Context

The white-faced ibis, a BLM Wyoming-listed sensitive species, nests from central Mexico to Louisiana and Texas and through the Great Basin, with isolated colonies in Alberta, New Mexico, California, Montana, North Dakota, Iowa, and Kansas (Ryder 1998).

Current Conditions

In Wyoming, this species is an uncommon summer resident present throughout much of the state, including the planning area (Orabona et al. 2012), although is not expected to nest in the planning area. Preferred nesting habitat includes tall emergent vegetation such as bulrushes and cattails growing as islands surrounded by water deeper than 18 inches. Feeding habitats can include wet hay meadows and flooded agricultural croplands, and marshes and shallow water ponds, lakes, and reservoirs (Ryder 1998). This species feeds primarily on aquatic invertebrates and insects.

Trends

The BBS Trend Analysis (Sauer et al. 2012) did not include data for this species in Wyoming. The trend for the United States was substantial and positive.

Yellow-billed Cuckoo

Regional Context

The western yellow-billed cuckoo, a BLM Wyoming-listed sensitive species, once ranged throughout the United States, southern Canada, and Mexico. The range of the western subspecies has been dramatically reduced and is mostly limited to California and Arizona (Carter 1998b).

Current Conditions

In Wyoming, this species is an uncommon summer resident, occupying cottonwood riparian habitats below 7,000 feet and urban areas. Typical prey includes insects, especially hairy caterpillars. It has been recorded in most areas of the state except for the montane regions (Orabona et al. 2012). Records obtained from Wyoming Birds Record Committee indicate this species, though rare, has been observed within the planning area (Wyoming Birds Record Committee 2011).

Trends

The BBS Trend Analysis (Sauer et al. 2012) did not include data for this species in Wyoming. Across all BBS routes in the United States from 1966 – 2011, the population trend was substantial and negative.

Mammals

Six special status nongame mammals are known or suspected to be present in the planning area and are designated as BLM sensitive. The black-footed ferret, a federally listed Endangered species, is not known or suspected to be present in the planning area. A discussion of this species is included because habitat is available and has been identified by the WGFD as potentially suitable for reintroduction efforts. Following is a brief description of existing conditions for nongame mammals identified in Table 3.37, “Special Status Wildlife in the Planning Area” (p. 362).

Black-footed Ferret

Regional Context

Historically, the distribution of black-footed ferrets closely matched that of prairie dogs, their primary prey, occurring throughout Texas, Oklahoma, New Mexico, Arizona, Utah, Kansas, North and South Dakota, Montana, Wyoming, Nebraska, and Colorado.

Current Conditions

Ferrets can occur in colonies of white-tailed or black-tailed prairie dogs. The USFWS has concluded that, at a minimum, potential habitat for the black-footed ferret must include a single white-tailed prairie dog colony of more than 1,000 acres, or a complex of smaller colonies within a 4.3 mile (7 kilometer) radius totaling 1,000 acres (USFWS 1988). The minimum colony size for black-tailed prairie dog is 1,000 acres (USFWS 2007). The last known wild population of black-footed ferrets was discovered in Meeteetse, Wyoming. Individuals from this population were captured and raised in protective captive breeding facilities in an effort to prevent extinction (Clark and Stromberg 1987). The WGFD has identified areas in the planning area that could be suitable for black-footed ferret reintroductions.

If this were to occur, the USDA Forest Service would be the lead agency responsible for the population that would likely be managed similar to the Shirley Basin/Medicine Bow experimental population. Portions of the Shirley Basin/Medicine Bow special rules that would likely be pertinent in the Buffalo planning area are provided below.

This population will be managed in accordance with a Cooperative Management Plan developed by the Shirley Basin/Medicine Bow Working Group. No person may take this species in the wild in the experimental population area, except as provided. Any person will a valid permit issued by the USFWS may take black-footed ferrets in the wild in the experimental population area for educational purposes, scientific purposes, the enhancement of propagation or survival of the species, zoological extinction, and other conservation purposes consistent with the Endangered Species Act and in accordance with applicable state fish and wildlife conservation laws and regulations. Any employee of the Service or WGFD who is designated for such purposes, when acting in the course of official duties, may take a black-footed ferret in the wild in the experimental population area if such action is necessary. A person may take a ferret in the wild within the experimental population area, provided such take is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Knowing or willful take will be prosecuted. Any taking pursuant the above must be reported immediately to the State Supervisor, Fish and Wildlife Enhancement, Fish and Wildlife Service, Cheyenne, Wyoming. No person shall possess, sell, deliver, carry, transport, ship, import, or export by any means whatsoever, any ferret or part thereof from the experimental population taken in violation of these regulations or in violation of applicable state fish and wildlife laws or regulations or the Endangered Species Act.

The reintroduced population will be continually monitored during the life of the project, including the use of radio telemetry and other remote sensing devices as appropriate. The status of the experimental population will be revised within the first five years after the first year of releases of black-footed ferrets to determine future management needs.

Trends

Black-footed ferret is a federally listed Endangered species (USFWS 1970). The black-footed ferret is closely associated with prairie dogs, and depend almost entirely on the prairie dog for its survival. The decline in populations of the ferret has been attributed to the reduction in the extensive prairie dog colonies that historically existed in the western United States.

Black-tailed Prairie Dog

Regional Context

Found throughout the Great Plains in short-grass and mixed-grass prairie areas (Fitzgerald et al. 1994), the black-tailed prairie dog has declined in population and range in recent years because of habitat destruction or disturbance and pest control. In Wyoming, this species is primarily found in isolated populations in the eastern half of the state (Clark and Stromberg 1987).

Current Conditions

The black-tailed prairie dog is a highly social, diurnally active, burrowing mammal. Aggregations of individual burrows, known as colonies, form the basic unit of prairie dog populations. Many other wildlife species, such as the black-footed ferret, swift fox, mountain plover, ferruginous hawk, and burrowing owl, depend on the black-tailed prairie dog for some portion of their life-cycle (USFWS 2000).

The black-tailed prairie dog was added to the list of Candidate species for federal listing on February 4, 2000 (Sovada et al. 2009). On August 12, 2004, the USFWS removed the black-tailed prairie dog from Candidate status. On December 2, 2008, the USFWS posted a 90-day finding and status review for the black-tailed prairie dog. BLM Wyoming considers prairie dogs a sensitive species. This species is considered a common resident, inhabiting short-grass and mid-grass habitats in eastern Wyoming (Orabona et al. 2012). Active and inactive prairie dog colonies are present in the planning area (Map 29).

Habitat loss and fragmentation, disease, and eradication programs remain serious threats to this species. Sylvatic plague has the potential to result in substantial adverse impacts to prairie dog populations. There are currently no effective management approaches to mitigate the spread of plague. Specific management actions currently in place in the planning area for the black-tailed prairie dog include conservation measures that protect against unauthorized control of black-tailed prairie dogs on BLM-administered lands, unauthorized use of poisons for black-tailed prairie dog control on BLM-administered lands, and managing grazing allotments containing black-tailed prairie dog colonies for a mosaic of range conditions. The black-tailed prairie dog is listed as a pest under the Wyoming Weed and Pest Act, and the WGFD does not currently regulate or monitor recreational shooting. Prairie dogs have been targets of intensive eradication programs; therefore conservation efforts are often poorly understood and not supported.

Trends

Population trends and status are not well documented. Current trend data have not been readily available to the general public and resource managers. There are extreme differences of opinion concerning acceptable statewide population objectives and appropriate management responses if objectives are not maintained.

Swift Fox

Regional Context

Current swift fox distribution is estimated to occur in southern Alberta, Saskatchewan, and Manitoba south through eastern Montana and Wyoming, northeastern Colorado, the Dakotas, Nebraska, western Kansas and Oklahoma, eastern New Mexico, and northern Texas; southern Oregon and southwestern Idaho south through Nevada and western Utah to southern California and Arizona (Sovada et al. 2009).

Current Conditions

In Wyoming, this species is considered a common resident and uses grasslands in the eastern plains, agricultural areas, irrigated native meadows, and the banks of roads and railroads (Orabona et al. 2012). The swift fox is found in short- and mixed-grass prairie habitats. It appears to prefer flat to gently rolling terrain. Although not an obligate, the swift fox often is present in association with prairie dog towns. The swift fox preys on small rodents, rabbits, and birds. In addition to these, the swift fox supplements its diet with insects during summer and fall. Dens are generally along slopes or ridges that offer good views of the surrounding area (Fitzgerald et al. 1994). Pups emerge from the den in June. Where swift fox are abundant, they occur at a density of one pair per 1,200 to 2,000 acres. Individuals can roam over 2,000 to 2,500 acres during a night of hunting (Clark and Stromberg 1987). This species is present in suitable habitats in the planning area, although baseline data are limited.

In January 2001, the USFWS did not support listing this species as Threatened under the Endangered Species Act (USFWS 2001) based on new biological information. Swift foxes are listed as a BLM Wyoming sensitive species. Human-related activities in the early 1800s through the mid 1900s contributed to a restricted distribution and abundance throughout the range of the swift fox. Some of these activities include the loss of native prairie habitat, predator-control campaigns, unregulated trapping and hunting, and rodent-control programs. Swift foxes are very vulnerable to trapping, poisoning, and death on highways.

Current management includes the following related to BLM-authorized activities:

- A swift fox survey is required in suitable swift fox habitat between April 15 and June 15.
  - If a swift fox den is identified, then a seasonal disturbance-free buffer of 0.25 mile is maintained between March 1 and August 31.
  - If no swift fox dens are identified, then surface-disturbing activities are allowed in suitable habitat until the following breeding season (March 1).

Trends

Population trends and distribution are poorly known in Wyoming.

Bats

There are four special status bat species present in the planning area (Table 3.37, “Special Status Wildlife in the Planning Area” (p. 362)). Although these species utilize a wide variety of habitats, caves and abandoned mines are important habitat components on which these species depend for roosts, nurseries, and hibernacula. Refer to the *Cave and Karst Resources* section of this chapter for additional information. WNSis caused by a fungus, and has become a threat to bats in the eastern United States, but has not been detected in Wyoming (BLM 2010d; Abel and Grenier 2011). Cave and abandoned mine-hibernating bats are at risk of contracting a fungus, *Geomyces destructans*, which invades and erodes the skin of hibernating bats, causing the bats to arouse more frequently and deplete fat stores more rapidly, which could result in mortality. Deaths can result from*Geomyces destructans* infection through starvation, dehydration, and exposure to cold temperatures (Abel and Grenier 2011).

Current Conditions

Management challenges for special status bats include habitat degradation, land conversion, incompatible land uses (e.g., industrial activities, human disturbance, use of contaminants, certain mine reclamation practices, cave closures, and insect control practices), lack of cottonwood and willow regeneration, bat collisions with wind turbines, and snag removal in preferred habitats. Management actions are intended to maintain and enhance the presence of bats and the habitats on which they depend.

Fringed Myotis

Regional Context

The fringed myotis, a BLM Wyoming-listed sensitive species, is known to occur from British Columbia through western North America to southern Mexico.

Current Conditions

In Wyoming, this species is present along the eastern edge of the state from the Black Hills to Laramie in Weston, Platte, Albany, and Laramie counties (BLM 2003c). This species is associated with a variety of vegetative communities, including montane meadows, sagebrush shrublands, desert scrub, mixed-grass prairies, and woodlands, although it appears to prefer coniferous forests (Fitzgerald et al. 1994). Caves, abandoned mines, and buildings are used as day and night roosts for colonies of up to several hundred individuals. Although no breeding has been reported, this species has been observed in the planning area (Orabona et al. 2012) and is suspected to be present in suitable habitats in the planning area.

Of all the populations in Wyoming, the Black Hill population of fringed myotis is considered to be of special concern due to its restricted distribution. Roosting habitat has been lost in Wyoming and continues to be threatened by abandoned mine reclamation, removal of old buildings, and renewed mining. The fringed myotis is extremely sensitive to disturbance at roost sites, particularly maternity colonies. Recreational activities (such as spelunking and rock climbing) can affect roosting bats in caves, abandoned mines, and rock crevices. Forest management and the removal of snags can result in loss of roosting habitat. Broad-scale insect control projects can affect the prey base of bats and other insectivores.

Trends

Population status, trends, and distribution of the fringed myotis in Wyoming are not known, making effective management difficult.

Long-eared Myotis

Regional Context

The long-eared myotis, a BLM Wyoming-listed sensitive species, occurs throughout the western portion of North America, south to Baja California. Wyoming is close to the eastern periphery of its range.

Current Conditions

Clark and Stromberg (1987) reported this species is distributed throughout Wyoming, with records in Park, Big Horn, Teton, Platte, Fremont, Sublette, Natrona, Sweetwater, Carbon, and Laramie counties. Scattered throughout most of the state at elevations between 5,000 and 9,800 feet, the long-eared myotis is considered uncommon. In sagebrush steppe habitat, they are likely limited to small stands of conifers. Preferred habitats include coniferous forests, including ponderosa pine and spruce-fir, forests, sagebrush shrublands, and grasslands (Orabona et al. 2012). This species roosts in caves, buildings, and mine tunnels (Clark and Stromberg 1987) and could be present in suitable habitats in the planning area.

Roosting habitat has been lost in Wyoming and continues to be threatened by abandoned mine reclamation, removal of old buildings, and renewed mining. Recreational activities (such as spelunking and rock climbing) can affect roosting bats in caves, abandoned mines, and rock crevices. Forest management and the removal of snags can result in loss of roosting habitat. Broad-scale insect control projects can affect the prey base of bats and other insectivores.

Trends

Population status, trends, and distribution of the long-eared myotis in Wyoming are not known, which precludes effective management.

Spotted Bat

Regional Context

The spotted bat, a BLM Wyoming-listed sensitive species, suspected to occur in western North America from Mexico to the southern border of British Columbia, is considered rare in Wyoming. Wyoming is on the northeast periphery of its range (BLM 2003c).

Current Conditions

Suitable habitat in Wyoming includes juniper and sagebrush shrublands, and short- and mixed-grass prairies (Orabona et al. 2012). Roosting sites in rock crevices and cliff complexes are also known to be important (BLM 2003c). This species is often described using cliffs over perennial water (Clark and Stromberg 1987). In Wyoming, occurrence records are restricted to the Big Horn Mountains and the southwestern portion of the state (Orabona et al. 2012). This species has been observed within the planning area (Cervoski et al. 2004). Activities such as rock climbing and quarry operations can affect roosting bats in rock crevices and cliffs. Broad-scale insect control projects can affect the prey base of bats and other insectivores.

Trends

Population status, trends, and distribution of the spotted bat in Wyoming are not entirely known, making effective management difficult. It is an extremely difficult species to inventory and monitor.

Townsend's Big-eared Bat

Regional Context

Townsend's big-eared bat, a BLM Wyoming-listed sensitive species, is most common throughout the western half of North America and occurs south into central Mexico, although it is considered rare in Wyoming. Although Wyoming forms part of the Core Population Area of the species' main range, it is distributed sparsely throughout the state (Clark and Stromberg 1987).

Current Conditions

This species has been recorded in Converse, Goshen, Platte, Crook, Fremont, Big Horn, Hot Springs, Sweetwater, Washakie, Park, and Johnson counties. Suitable habitats in Wyoming include deciduous forests, dry coniferous forests, sagebrush and other shrublands, short-grass and mixed-grass prairies, and juniper woodlands. This species uses caves, abandoned mines, buildings, and rock outcrops for day and night roosts and hibernation sites (Orabona et al. 2012). Although no breeding has been reported, this species has been observed in the planning area (Orabona et al. 2012).

Roosting habitat has been lost in Wyoming and continues to be threatened by abandoned mine reclamation and renewed mining. Townsend's big-eared bat is extremely sensitive to disturbance at maternity roosts and hibernacula. Recreational activities (such as spelunking) can affect roosting bats in caves and abandoned mines. Broad-scale insect control projects can affect the prey base of bats and other insectivores.

Trends

Population status, trends, and distribution of the Townsend's big-eared bat in Wyoming are not known, making effective management difficult.

Reptiles and Amphibians

Columbia Spotted Frog

Regional Context

The Columbia spotted frog, a BLM Wyoming-listed sensitive species, occurs throughout much of British Columbia and in Washington, Oregon, Idaho, Montana, Nevada, Utah, and Wyoming (Stebbins 1985). Wyoming is on the eastern edge of the frog's range, where it is known from Park, Teton, Lincoln, Fremont, Sheridan, and Sublette counties. The primary population is in the northwest part of the state, where it is contiguous with populations in Idaho and Montana (BLM 2003c).

Current Conditions

There is a glacial disjunct population in the Big Horn Mountains about 100 miles east of the primary, contiguous population. It is confined to the headwaters of the South Tongue River drainage and its tributaries in Sheridan County (Garber 1994). There are no other known populations in the planning area. In Wyoming, suitable habitats are present in foothills and montane zones, usually near permanent water such as ponds, sloughs, small streams, and beaver ponds. This species might avoid areas with warm stagnant water and dense cattails. It breeds in old oxbow ponds with no fish and with emergent sedges in wet meadows at the edge of lodgepole pine forests (Garber 1994). Adult spotted frogs typically feed on insects, invertebrates, and small vertebrates, including tadpoles and other frogs.

Trends

The Big Horn Mountain population is likely limited in its range and vulnerable to extirpation. Introduced species, such as the bullfrog, are thought to be a factor in the decline of this species. Other factors could include alterations in habitat quality. The source and extent of these alterations is not well understood.

Northern Leopard Frog

Regional Context

The Northern leopard frog, a BLM Wyoming-listed sensitive species, is found throughout much of the southern half of Canada, south through the upper mid west and central plains states, westward into Idaho, Nevada, northern Arizona, and New Mexico (Stebbins 1985). The northern leopard frog has experienced contractions in its range resulting from local extirpations of breeding populations, particularly in western North America (Wagner 1997).

Current Conditions

In Wyoming, this species is present in cattail marshes and beaver ponds from the plains to montane conditions as high as 9,000 feet (Orabona et al. 2012). Adult leopard frogs typically feed on insects, invertebrates, and small vertebrates, including tadpoles, snakes, and fish. This species is present in suitable habitats throughout the planning area.

While no single factor has been identified as the overwhelming cause for the reduction in leopard frog populations, there are several contributing factors, including disease (red-leg and chytrid), introduced species (bullfrogs, fish, and crayfish), chemicals (e.g., atrazine and rotenone), and habitat loss/alteration/fragmentation. Habitat changes and other factors could be adversely affecting this species, but lack of data precludes identification of specific problems and development of management recommendations. Population status, distribution, and habitat data are lacking for this species.

Trends

While northern leopard frogs were once very common, their populations are currently undergoing a range-wide dramatic decline.

3.4.9.4. Trends

Trend information where available was discussed by species within the *Current Conditions* section.

3.4.9.5. Key Features

Key features for special status wildlife species include: riparian corridors (see key features in the *Fish and Wildlife Resources – Fish* section) and the following:

- *Prairie Dog Colonies* – Prairie dogs have been described as a keystone species and an ecological engineer. They build prairie dog towns, which provide habitat for more than 170 species. Of species regularly associated with prairie dog colonies, six are on the BLM Wyoming sensitive species list – swift fox, mountain plover, ferruginous hawk, western burrowing owl, loggerhead shrike, and long-billed curlew. This biodiversity issue is relevant in the planning area.

- *Sagebrush Steppe Ecosystems* – Sagebrush steppe ecosystems support a variety of species. Sagebrush obligates are animals that cannot survive without sagebrush and its associated perennial grasses and forbs; that is, species that require sagebrush for some part of their life-cycle. Sagebrush obligates in the Powder River Basin, listed as sensitive species by BLM Wyoming, include Greater Sage-Grouse, Brewer's sparrow, sage thrasher, and sage sparrow.

3.5. Heritage and Visual Resources

3.5.1. Cultural Resources

Cultural resources are tangible, physical evidence or expression of past human activity in the form of material items produced by human workmanship or use, and elements of the natural environment that were altered by people's activities. Examples of cultural resources include artifact scatters, animal traps, rock art, battle sites, trails and structures. Cultural resources can possess important scientific information about the past and may be valuable to the cultural and social heritage of our citizens, locally, regionally and nationally. Archeologists, anthropologists, ethnographers, historians and other researchers study the remains of the past in an effort to identify the forces that have shaped human history, and to define how cultures originate, develop and interact with the environment. Cultural resources in the form of emigrant trails, rock art, campsites, mines, ghost towns, homesteads, or sacred sites can provide people with visible links to their past and reminders of their ancestral heritage. In turn, this can help to foster a sense of belonging and pride in our cultural and historical backgrounds.

3.5.1.1. Regional Context

The archeology of the Northwestern Plains is divided into two major timeframes. Prehistoric refers to a timeframe beginning with the arrival of humans into North American around 12,000 years ago and ends with the arrival of Euro-American into the region in the early 1800s. The term historic generally refers to the time period after the arrival of Euro-Americans and to events that typically have associated written records. Physical remains and traces of events associated with each time period can be considered archeological sites, many of which are present in the planning area. The BLM is obligated by law, regulation and policy to preserve and protect significant archeological sites.

Prehistoric Context

The Buffalo planning area is mostly within the Northwest Plains physiographic region, and partially in the Rocky Mountains. This distinction is important in a discussion of cultural prehistory, because some defined prehistoric cultural complexes theoretically occur in the mountains and not on the plains, and vice-versa. Several notable researchers have established these localized cultural complexes and the regional cultural chronology over the last several decades (Mulloy 1958; Frison 1991). Although not always corresponding in names, divisions, or dates of complexes, these chronologies are all generally based on and recognized by projectile point typology and other stone tools as culturally diagnostic markers (Frison et al. 1996).

The Frison (1991) summary of the Northwest Plains and proposed prehistoric chronology is generally accepted as the primary narrative for the region. Furthermore, the chronological framework was partially established by work conducted on and data retrieved from significant sites within Buffalo planning area. Therefore, for the purposes of this discussion, this overview uses the Frison (1991) chronology, which ranges from the Paleoindian period to the Protohistoric period, for a span of nearly 12,000 years.

The Paleoindian period is considered the first human occupation of the New World; however, the timing and location of the first migrations is a topic of debate. Generally believed to have occurred sometime after the retreat of the Continental Glacier, the currently accepted chronology of the Paleoindian period is considered to start roughly 12,000 years before present with the Clovis culture and ending with the Late Paleoindian Lanceolate period around 7,800 years before present. However, earlier dates are not only possible but ultimately probable, considering the contemporaneous Clovis cultural materials found all across North and South America.

Paleoindian cultures are believed to have been opportunistic hunters and gatherers who relied on big game hunting and supplemented their diets with plant resources. The climate immediately after the glacial retreat is believed to have been much wetter than at present. The projectile point technology is characterized by large lanceolate spear points, thought to have been used as thrusting spears or atlatl darts, especially at the beginning of the period. By the middle of the Paleoindian period, stemmed points began to appear; by the end of the period, many different point styles are evident. The main complexes derived from these projectile points on the Northwest Plains are Clovis, Goshen, Folsom, Hell Gap-Agate Basin, Alberta-Cody and Late Paleoindian Lanceolate, with minor traditions such as the Foothill-Mountain Paleoindian.

The Early Archaic period is recognized by side notched projectile points dating from approximately 8,000 years before present to 5,500 years before present (Frison 1991) and a distinct change in subsistence strategies. A more intensive use of plant products is suggested in the Early Archaic by the increased number of stone-lined roasting pits and grinding-stone artifacts recovered from sites of this age. This change in subsistence strategy could have been due to a reduced animal population (as well as human population) from a drier climate across the Plains known as the Altithermal climatic episode, which occurred at roughly the same time (Frison 1991). It is not clear at this time if Early Archaic age sites are few in number due to low human populations or because of increased erosion during the drier climatic episode. Either way, the Early Archaic period is underrepresented on the Northwest Plains.

The Middle Archaic period of the northwest plains is usually synonymous with the McKean complex, which dates from 5,500 years before present to 3,500 years before present. Characterized by a style of projectile points, the period also sees a proliferation in the grinding stones and stylized forms of food preparation pits that made their appearance in earlier periods (Frison 1991). In addition, the earliest stone circle sites are attributed to the Middle Archaic period, which suggests a possible change in habitation structures for prehistoric cultures. This change could represent the origin of tipis with the rocks used to hold down hide covers, or for other log-structure dwellings with stones used as a foundation (Frison 1991).

The Late Archaic period of northwest plains prehistory dates from 3,500 to 1,500 years before present. The period is recognized by corner-notched dart points described as the Pelican Lake, Yonkee, and Besant cultural horizons (Frison 1991). The Pelican Lake variant is widespread in the northern Plains and Rocky Mountains, whereas the Yonkee is less widespread and is mostly found within the Powder River Basin of Montana and Wyoming. The Besant variant appears later on the Plains at approximately 2,000 years before present (Frison 1991). The Late Archaic period also is known for large communal bison kills in arroyo traps or bison pounds.

The Late Prehistoric period of the northwest Plains prehistory dates from approximately 1,500 to 200 years before present. The period is recognized by the emergence of arrow points from the introduction of the bow and arrow (Frison 1991). Additionally, the period sees a proliferation of stone circles and diagnostic pottery of various traditions (Frison et al. 1996). Large communal bison hunts also increased during the Late Prehistoric Period.

The Protohistoric period of the Northwest Plains basically starts with the contact of Native Americans with Europeans, which occurred up to 250 years ago or more. The period can generally be dated from 250 years before present to the historic period, which started roughly 130 years ago. The Protohistoric archeological record is characterized by horses, glass beads, metal artifacts, or other European trade items (Frison et al. 1996).

The introduction of the horse brought the most significant cultural changes to Plains Indian groups (Frison 1991). Acquisition of horses increased mobility and contact with other groups, changed hunting techniques, and likely altered political structures (Aaberg et al. 2006). Regarding local area tribes, Shoshonean groups are believed to have been the first to acquire horses (in the first quarter of the 18th Century), with the Crow acquiring them shortly thereafter (Frison 1991).

Historic Context

By the early 1800's, fur trappers were exploring the Big Horn Mountains and Powder River Basin. In 1807 George Drouillard, a former member of the Lewis and Clark Expedition, explored and trapped portions of the upper Yellowstone, Bighorn, and Tongue River drainages, drafting a sketch map of the pertinent geographic features (Skarsten 1964). Another exploration party under the command of Jean Baptiste Champlain and Ezekiel Williams trapped the drainages on the eastern flanks of the Big Horn Mountains. The next major commercial expedition through the northwest plains was carried by the American Fur Company and Pacific Fur Company in 1811 (Allen 1997; Chittenden 1954; Goetzmann 1966; Swagerty 2001). An overland party under the command of Wilson Price Hunt was dispatched to the Columbia River. The group ascended the Missouri River from St. Louis and turned inland at the confluence of the Grand River. Proceeding west, Hunt's party reached the Little Missouri River and followed its course southwest into the Powder River Basin (Chittenden 1954; Goetzmann 1966). The expedition was subsequently guided by the Crow Indians and another trapper, Edward Rose, through Powder River Pass into the Wind River country in September 1811 (Chittenden 1954; Goetzmann 1966).

Rocky Mountain Fur Company trapping parties under the commands of William Ashley, Jim Bridger, John Weber, Robert Campbell, and Jedediah Smith traversed the area of present-day Wyoming between 1822 and 1825 (Allen 1997; Chittenden 1954; Dale 1917; Goetzmann 1966; Morgan 1953; Swagerty 2001). In summer 1823 Smith followed the Belle Fourche River into the Powder River valley and crossed west over the mountains via Granite Pass into the Bighorn valley (Allen 1997; Chittenden 1954; Dale 1917; Goetzmann 1966; Morgan 1953). English fur trader Benjamin Bonneville, whose trapping forays were primarily west of the Rocky Mountains dispatched Antonio Montero to establish a trading post on the Powder River. The post, referred to as the "Portuguese Houses," was constructed in 1828 and eventually abandoned in 1836 to 1837 (Watson 1982). The demise of the fur trade by 1840 was precipitated by decreased demands for pelts and the suspension of financing for fur trade ventures in 1837 (Watson 1982). In spite of this, the descriptions and delineation of the Rocky Mountain region by these fur traders provided the catalyst for subsequent Euroamerican settlement.

Several expeditions with varying goals travelled through the Powder River Basin in the 1840s and 1850s. Jesuit missionary Jean Baptiste DeSmet went through the basin along the east face of the Bighorns in 1849. Sir George Gore travelled throughout the Buffalo planning area in 1855 and 1856. Gore was a wealthy Scottish aristocrat who spent two years on a hunting expedition in the western US. In 1859 and 1860, the Raynolds Expedition was the first systematic military effort to map and describe the topography in the planning area. William F. Raynolds was a captain in the Corps of Topographical Engineers, a branch of the United States Army. The expedition travelled along the east face of the Bighorns, part of their route later becoming the Bozeman Trail. The Raynolds party included geologist Ferdinand V. Hayden who would later explore and document the Pumpkin Buttes.

In 1863 John Bozeman scouted a route through the Powder River Basin that would provide a direct overland route for freight traffic and immigrants to the gold fields in western Montana. The later establishment of the Bozeman Trail and the efforts of the United States Army to protect travelers along the route led to “Red Cloud’s War” between the United States Army and a combined force of Sioux, Cheyenne, and Arapaho. Although the U.S. Army established several forts along the Bozeman Trail, it never fully succeeded in protecting travelers along the trial. The Fetterman Battle, near Fort Phil Kearney, resulted in the worst defeat of the U.S. Army at the hands of the Plains Indians as Fetterman and his entire command of 80 soldiers were killed. Failing to achieve success in region, the Army eventually abandoned its efforts with the signing of the second Treaty of Fort Laramie in 1868, which closed the Bozeman Trail and ceded the majority of the Buffalo planning area to the Sioux.

What is referred to as the “Great Sioux War” began in the early 1870s as settlers and miners began to break the provisions of the 1868 Treaty of Fort Laramie and venture into land set aside for the tribes. The discovery of gold in the Black Hills resulted in hundreds of miners entering what was then Sioux territory. After a series of conflicts between the tribes and white settlers and miners in reservation lands, the U.S. Army was once again at war with the Sioux, the Cheyenne, and the Arapahoe. The climax of the war was the Battle of Little Bighorn, in which General George Custer and his entire command of 300 men were killed. The most significant events associated with the war within the planning area occurred after the Battle of Little Bighorn as the U.S. Army increased its efforts to remove the tribes from the area. Cantonment Reno was constructed as a military supply fort on the Bozeman Trail. The Dull Knife Battle in the Southern Big Horn Mountains resulted in the Northern Cheyenne Tribe loosing the majority of their possessions and horses resulting in their eventual surrender. General George Crook later undertook a failed winter campaign to locate the Sioux in the Powder River Basin. By 1877 the Great Sioux War was over. The Sioux, Cheyenne, and Arapaho tribes surrendered to the U.S. Army, and were forcibly removed from the Powder River Basin, leaving it open for stock grazing and homesteading.

By the early 1880s, the open-range practice of turning cattle lose on the range in the fall and gathering them in the spring, with no supervision from cowboys, was in full swing (Larson 1978). Small land and livestock owners started to band together as early as 1871. The booming cattle industry was dominated by cattle kings, represented by the Wyoming Stock Growers Association. During the early 1880s, the cattle industry in Wyoming peaked. An estimated 175,000 cattle grazed the open range in Johnson County in 1884, and in 1886, more than 6,000 sheep also ranged in Johnson County (Bollinger and the Jim Gatchell Memorial Museum 2009).

In 1890, Wyoming became the 44th state in the Nation. The tensions between the small and large livestock growers would culminate in the early 1890s with the Johnson County War, which "ranks as the most notorious event in the history of Wyoming" (Larson 1978). The big operators began to take matters into their own hands beginning with the lynching of James Averill and Ella "Cattle Kate" Watson near Independence Rock on July 20, 1889 (Larson 1978). Eventually, approximately 50 invaders hired by large cattle operators, invaded Johnson County and killed both Nick Ray and Nate Champion at the KC Ranch house on April 9, 1892 (Bollinger and the Jim Gatchell Memorial Museum 2009). The invaders stayed the night at the TA Ranch but were surrounded the next day by a posse that had formed in Buffalo after being informed of the Ray and Champion deaths (Bollinger and the Jim Gatchell Memorial Museum 2009). The invaders barricaded themselves at the ranch and held off the Buffalo posse until April 13, at which time soldiers from Fort McKinney arrived and arrested the invaders (Bollinger and the Jim Gatchell Memorial Museum 2009). None of the invaders was convicted of a crime. The Johnson County War was a major political issue in the 1892 elections that ended with Democratic victories in the gubernatorial and the congressional races.

Economic depression was widespread in the United States throughout the 1890s, and the cattle industry shrank considerably (Larson 1978). However, the fledgling oil industry produced the first oil well in the Shannon Field of the Salt Creek oil basin in 1889 (Larson 1978). The first oil field established in the Powder River Basin, in 1887, was in the Moorcroft area (Metz 1992). The Salt Creek oil field boomed during World War I as demand for oil peaked in 1917 (Metz 1992). The Teapot Dome scandal, along with the depressed oil market and the lack of transportation, led the Wyoming oil industry into a "lull until after the Depression" (Metz 1992). Between 1900 and 1938, approximately 6,700 wells were drilled for oil and gas in Wyoming" (Metz 1992).

Throughout the 1890s and until 1901, the Hole-in-the-Wall Gang, a loose knit group of outlaws sometimes led by Butch Cassidy, were based out of the Red Wall or Hole-in-the-Wall southwest of Kaycee. Other famous outlaws reported as being in the Powder River Basin include Frank James, who used the pseudonym McKinney while he rode with Big Nose George Parrott's gang in 1878 (Patterson 1982). Nate Champion, who was killed during the Johnson County War, was considered by some to be an outlaw who rustled cattle. Patterson (1982) claims, "many members of Butch Cassidy's Wild Bunch of the 1890s got their start riding with Champion's rustlers, including the Logan brothers, Flat Nose George Currie, and Tom O'Day."

The expansion of the Homestead Act in 1909 brought a new wave of homesteaders to the Powder River Basin (SWCA 2006) and, in 1916, the Stock Raising Act allowed an individual to claim 640 acres for grazing, although the federal government retained the mineral rights. Many dry-land farmers "flocked to the state in the years 1909-1913" (Larson 1978). World War I brought an increased demand for agricultural goods and encouraged the growth of farms and ranches, which were becoming more mechanized, but also going into debt (Cassity 2006). After World War I, agricultural production in the Powder River Basin remained high, never dropping to prewar levels, which led to excess products on the market and drove prices down (Cassity 2006). In addition, a severe drought hit the area in 1919. All of these factors combined to lead to the large scale abandonment of homesteads and/or banks repossessing land (Cassity 2006).

Agriculture, oil, and coal mining were economically very important to Wyoming, and all three industries suffered setbacks in 1920 (Larson 1978). National coal strikes in 1919 and 1922 affected the state, and petroleum production declined after 1924 (Larson 1978). In the Powder River Basin, Cassity reports that the average farm and ranch size doubled between 1920 and 1929, due in part to larger operations expanding and buying out smaller farms and ranches as mortgages foreclosed or they were "weakened by the tight money supply and declining prices on their products" (Cassity 2006).

By 1940, farms were no longer family businesses. Instead, large corporate farms that specialized in one crop, or cattle or sheep, were the most successful and numerous, while small landholders and farmers were not economically viable (Cassity 2006). The principal industries of Wyoming, and the Powder River Basin, including agriculture, livestock, transportation, oil, and coal prospered during World War II, effectively ending the Great Depression (Larson 1978).

Regulatory Context

The National Historic Preservation Act (NHPA) requires federal agencies to consider impacts to historic properties prior to making land use decisions. Historic properties are localities that are listed on or are eligible for listing on the National Register of Historic Places (NRHP). Historic properties can include (but are not limited to) archeological sites, historic sites, or properties significant to tribes for spiritual or religious significance. Although federal agencies are required to consider impacts to such sites, they are not required to protect them. Through consultation with State Historic Preservation Officers, tribes and other entities; impacts to historic properties can be mitigated. Although mitigation is an option under the law, it is Bureau policy to initially attempt to avoid impacts to historic properties.

Federal agencies are required to protect and preserve certain types of sites that are significant to tribes. The American Indian Religious Freedom Act (AIRFA) is a civil rights act requiring federal agencies to consider impacts to sites that are important to tribes for religious purposes. The Native American Graves Protection and Repatriation Act (NAGPRA) protects Native American graves on federal surface and requires federal agencies to repatriate Native American human remains and funerary objects taken from federal surface to tribes.

3.5.1.2. Indicators

The resource indicator for cultural resources is the degree of loss of characteristics that qualify a historic property for listing on the NRHP or something that diminishes the value of an area important to Native American or other traditional communities. Natural or accelerated erosion, project construction, unauthorized collection, and vandalism can remove, alter, or damage characteristics that make the resource significant. Any impact to a cultural resource is difficult to measure without baseline data, which is typically recorded on a site form. The majority of cultural resource sites in the planning area have not been recorded. Inventories are typically conducted, sites are recorded and historic properties are avoided in response to project applications which reduces or minimizes the loss of characteristics that qualify a historic property for listing on the NRHP. On a much smaller scale, sites are recorded in a proactive manner in order to gather baseline data which is used in the event of natural impacts or unauthorized collection. Any loss of the characteristics that make a historic property significant could be addressed through mitigation techniques including site stabilization, repair, additional recordation or site avoidance.

3.5.1.3. Current Condition

Archeological investigations in the planning area started in the 1950s with the Smithsonian Institution's Missouri River Basin surveys. Since the 1970s, however, most investigations were associated with NHPA compliance as a result of coal, oil, gas, and other minerals exploration and development. The numbers of cultural resources inventories and associated surveyed acres have increased and decreased over the decades with the boom and bust cycle of the oil and gas industry. Since the late 1990s, several thousand sites have been discovered during over one million acres of inventory associated with CBNG development in the Powder River Basin.

The planning area is in the Northwest Plains and Rocky Mountain physiographic regions. For analysis purposes, the area has been divided into four cultural subregions based on present-day ecological conditions (Chapman et al. 2004). These subregions are delineated based on such factors as geology, physiography, hydrology, climate, soils, wildlife, vegetation, current land use, and known cultural resource site locations. A discussion of subregions is necessary to understand how cultures adapted, subsisted, and settled in this region. As Wood (2003) states in reference to the sub-regions of the Great Plains, "These subareas, for the most part, are reflected in the cultural systems of the people who lived within them." Map 39 shows the analyzed cultural subregions for the planning area in Campbell, Johnson, and Sheridan counties. Note that this analysis excludes the higher-elevation ecoregions of the Big Horn Mountains since this subregion is managed by the USFS. Table 3.38, "Summary of Prehistoric Sites by Cultural Period and Subregion in the Planning Area" (p. 393) lists prehistoric sites chronologically by cultural period for each subregion in the planning area.

Table 3.38. Summary of Prehistoric Sites by Cultural Period and Subregion in the Planning Area

Cultural Subregion	Unknown Prehistoric	Paleoin-dian	Early Archaic	Middle Archaic	Late Archaic	General Archaic	Late Pre-historic	Proto-historic	Total
Grassland	2,626	44	44	136	245	52	393	21	3,561
Powder River Basin	2,240	12	15	67	122	20	197	21	2,694
Tongue River	243	3	2	7	10	1	16	5	287
Southern Big Horn Mountains	366	6	2	15	30	14	42	4	479
Buffalo Field Office Planning Area[1]	5,475	65	63	225	407	87	648	51	7,021
Source: BLM 2012f [1] Does not include Bighorn National Forest									

Table 3.39, "Subregions and Overall Cultural Resource Statistics of the Buffalo Planning Area" (p. 394) identifies the subregions and the overall cultural resource statistics of the planning area.

Table 3.39. Subregions and Overall Cultural Resource Statistics of the Buffalo Planning Area

Subregion	Total Acres	BLM Acres[1]	BLM %	Inventory Acres[2]	Number of Sites	Number of Sites with Prehistoric Components[3]	Number of Sites with Historic Components[3]	Number of Sites Eligible for NRHP[4]	Number Sites Not Eligible for NRHP	Number of Unevaluated Sites	Inventoried Acres Per Site
Tongue River	791,212	17,357	2	48,341	662	262	425	175	258	229	73
Powder River Basin	3,166,031	504,325	16	802,500	5,816	4,056	2,410	591	4,458	767	138
Southern Big Horn Mountains	484,480	145,629	30	28,803	579	477	125	142	253	184	50
Grasslands	2,195,669	107,143	5	861,970	4,595	3,359	1,607	519	3,354	722	188
Totals	6,637,392	774,454	12	1,741,614	11,652	8,154	4,567	1,427	8,323	1,902	149

Source: BLM 2012f

Note: Some totals might not equal the sums of the values.
[1]Derived from land status maps supplied from the Wyoming Geographic Information Science Center.
[2]Includes overlapping survey areas; assumes 100-foot-wide survey corridor for linear inventory.
[3]Number of components will not match number of sites because a site can have both historic and prehistoric components.
[4]Includes eligible sites, listed sites, National Landmarks, and National Monuments.

BLM Bureau of Land Management
NRHP National Register of Historic Places

The Southern Big Horn Subregion has a much higher density of sites than the rest of the planning area. There are also more numerous significant prehistoric sites such as rock art and rock shelters in the Southern Big Horn Subregion. The Tongue River Subregion also has a higher density of sites than other subregions, but the majority of those sites are historic. The data shows that the Grassland and Powder River Subregions have been inventoried more extensively than other subregions, a result of CBNG and coal development in these areas. These subregions contain several significant sites (Carter-Kerr-McGee Site, Ruby Site, Cordero Mine Site, etc.), but at a lower density than the Southern Big Horn and Tongue River Subregions.

Historic Trails

There are numerous historic trails in the planning area, most notably the Bozeman Trail which is listed on the NRHP. Much of the trail has disappeared or has been destroyed by recent roads and, where evident, appears as sporadic “U” shaped wagon ruts or two-track roads. There are very few intact significant portions of the Bozeman Trail on BLM surface in the planning area, the most notable example being near the crossing of Crazy Woman Creek. Other historic trails in the planning area eligible for listing on the NRHP include the Deadwood Trail, Sawyers Expedition Route, Crook Scout Route, Black and Yellow Trail, and the Texas Trail.

Buried Cultural Resources

Alluvial and colluvial deposits have potential to contain intact buried cultural resources, but consistently locating such resources is difficult. A geoarcheological assessment associated with the Department of Energy's PUMP III (Eckerle et al. 2005) study examined general depositional areas throughout the planning area that have the potential to contain such resources. Relying on soil geology and archeological data, the study found that alluvial and colluvial deposits are more likely to contain buried cultural resources than others. The study also noted that due to some unique circumstances in the planning area buried cultural resources are difficult to locate in cutbanks or in soil profiles exposed by construction equipment. The PUMP III report makes a statistical assumption that, in lieu of an obvious soil horizon and estimating a typical artifact density of approximately 100 per square meter, the probability of encountering a buried site in a cutbank (or construction trench) is an astonishingly low 0.3% (Eckerle et al. 2005). This notion is reinforced by the fact that many significant buried archeological sites discovered in the 1970s and 1980s attracted academic investigations (Carter-Kerr-McGee Site, Sisters Hill Site, Ruby Site, etc.), but after nearly two million acres of archeological inventory no recent sites eliciting such interest have been discovered. Although the geology of planning area exhibits the preservation traits to hold numerous significant buried sites, such sites are very difficult to discover.

Traditional Cultural Properties and Sacred Sites

As mandated by the NHPA, the BLM primarily consults Native American tribes about impacts to sacred sites or Traditional Cultural Properties (TCPs), although tribal concerns can go beyond impacts to specific archeological sites. Tribal representatives indicate that archeologists are not adequately trained to identify areas important to a tribe, and suggest the use of trained tribal members to do so. Tribes also indicate sacred sites are not necessarily archeological in nature and may be more properly associated with things such as geographic features or plant communities. To date the Buffalo Field Office has not utilized Native American inventory before making land use decisions.

In 2006 the BLM, in consultation with the Wyoming State Historic Preservation Office (SHPO) and 15 tribes, determined that Pumpkin Buttes is a TCP. The site consists of four prominent buttes on the divide between the Belle Fourche and Powder River Basins. Several tribes identified specific sacred sites and indicated that there could be numerous undocumented sacred sites, such as burials and offering sites, on the buttes. The buttes are also the origin place for a significant ceremony related to a specific tribe. Many tribes indicated a desire to utilize the buttes for ceremonial and plant-gathering activities.

Native American burials have been located and in some cases inadvertently removed from public lands in the planning area. The Native American Graves Protection and Repatriation Act mandates that all Native American human remains and associated funerary objects on public lands be protected, and if they are removed, they are to be repatriated. The Buffalo Field Office is actively working to repatriate Native American human remains and associated funerary objects removed from BLM-administered lands. Occasionally, tribes request that such remains or funerary objects are re-interred on BLM-administered surface.

Management Challenges

There are several unique management challenges associated with cultural resources in the planning area. Consistent assessments of site conditions throughout the planning area are difficult given the recent focus on energy development projects. Areas that are developed for fluid minerals or coal are often intensively inventoried, while other areas with significant resources (such as the South Big Horns) are not. Impacts to setting of historic properties presents a difficult management challenge in the face of energy development. Increased energy development is also leading to other unique challenges as hundreds of thousands of acres are inventoried and documented.

Timely documentation of site conditions is one of the greatest management challenges for the Buffalo Field Office. There are numerous significant sites, such as cave sites in the Middle Fork area, the BLM has not visited since the 1970s. Some sites, such as Cantonment Reno and the Sweem-Taylor rockshelter, have associated interpretive facilities, but are not regularly patrolled to check for signs of vandalism or natural erosion. Other sensitive sites, such as burial sites or the Pumpkin Buttes TCP, do not receive adequate BLM visitation to immediately address imminent threats.

Hundreds of archeological sites are discovered and recorded each year as a result of inventory associated with energy development. Most of these sites are assessed for their eligibility for listing on the NRHP. Site condition is assessed as part of the eligibility determination. Site condition can change over time due to such actions as erosion, grazing, unauthorized collection, and vandalism. Because the condition of a site can readily change, monitoring is necessary. Due to the recent increased emphasis on energy development, the Buffalo Field Office has focused on permitting and has performed minimal monitoring.

There are nationally significant historic sites in the planning area, such as Cantonment Reno, that experience human and natural impacts. The site, on BLM surface, is a rare example of a military fort from the late 19th Century, and contains well-defined feature foundations and thousands of buried artifacts. Although there is no legal public access, there are documented cases of unauthorized excavation and collection at Cantonment Reno. The site is on a floodplain and could soon be exposed to erosion from an encroaching oxbow bend in the Powder River. Other nationally significant historic sites on or partially on BLM surface that could be experiencing similar impacts are the Dull Knife Battlefield, Crazy Woman Battle site, and portions of the Bozeman Trail.

Archeological sites in rockshelters are typically significant because they are often stratified and tend to preserve artifacts and features more than open-air sites. There are numerous rockshelters in the Middle Fork and other similar canyons in the South Big Horn Mountains that require special consideration. Many of the known rockshelters in the planning area have not been properly recorded or patrolled in the last 30 years. Looters often target rockshelters as likely places to recover artifacts, and it is very likely that significant rockshelters on BLM surface have been vandalized.

One of the significant rockshelter sites in the planning area that has been adversely affected is the Sweem-Taylor rockshelter. Excavation by an amateur society in the 1950s removed almost all of the cultural deposits inside the shelter. Amateurs performed the work using dated excavation methods, and no peer reviewed scientific description or analysis of the finds was published. After the excavation, looters removed the remaining cultural layers inside the shelter. Although a barrier fence between an access road and the site and an interpretive sign were installed in the 1980s, most of the damage had been done. Due to the complete removal of the cultural layers, the site cannot be analyzed using modern technology and professional methods, and now contains very little important scientific information.

Rock art is a fragile resource that can be affected or altered by many natural or human-caused factors. The majority of rock art in the planning area has modern graffiti near or on top of the art. Rock art on boulders inside the Sweem-Taylor rockshelter were destroyed or removed during unauthorized excavation. Smoke from modern campfires inside the shelter also led to the destruction of some rock art. Rock art erodes due to natural weathering, especially if it is placed on soft sandstone. Site 48JO108 was recorded in 1978 as a fairly well defined pictograph on a sandstone cliff face. During a site visit in 2009, it was noted that almost half the pictograph was no longer distinguishable due to natural weathering.

Preservation of the setting of historic trails presents a unique management challenge. Setting is one of the aspects that can contribute to the integrity of a historic property. For example, if an individual on a portion the Bozeman Trail can observe the same type of landscape adjacent the trail as a traveler on the trail in the early 1860s did, the site retains its historic setting. The addition of oil and gas facilities to the setting of a historic trail obviously does not give an observer the impression that the historic setting is intact. With setting being a subjective term, it is a difficult concept to effectively manage. It is essential that the person assessing the setting has a thorough knowledge of both the history of the landscape and the historic property being evaluated. An observer who is not familiar with the Wyoming landscape may feel that a trail segment adjacent to a crested wheat field without visible oil and gas facilities or modern buildings retains its historic setting. Someone familiar with the history of the area could identify the crested wheat as a non-native species which is only established by mechanical seeding, and determine that the historic setting has been compromised.

Setting can contribute to the integrity of any historic property, not just historic trails. There are historic homesteads in the planning area that retain their historic setting. The Sievers Ranch, south of Pumpkin Buttes, is one such property. Setting can also contribute to the integrity of sacred sites or traditional cultural properties. For example, the Pumpkin Buttes traditional cultural property retains most of its integrity of setting. The status of an intact setting can change after an initial assessment. After the BLM originally determined that the Sievers Ranch setting was intact, coalbed natural gas facilities were installed near the site on private surface/private minerals. The site setting is no longer considered intact. If the facilities were removed and the land recontoured and revegetated to its original state, the setting could once again be considered intact.

Archeological sites are fragile nonrenewable resources. Sites in the planning area have been adversely affected or destroyed through various actions. The BLM has taken measures to reduce impacts to some sites, but hundreds of significant sites do not have specific protection measures. Although monitoring is necessary to document and prevent site damage, the Buffalo Field Office does not have the proper planning document or resources to do so.

3.5.1.4. Trends

If the demand for production of federally owned minerals increases or remains the same, there will be an increased need to identify cultural resources. Intensive inventory is required before approval of any surface-disturbing activity associated with minerals development. In the Powder River Basin EIS, the BLM suggested that operators have their permittees perform large block inventories to better plan large projects with multiple wells and associated infrastructure, and most operators have complied with this request. The contracted reports are used to determine if archeological sites eligible for listing on the NRHP will be affected by the proposed action. Sites that not eligible for listing on the NRHP are not avoided and could be destroyed during construction. It is BLM policy (as outlined in BLM Manual 8140) that historic properties are avoided by at least 100 feet. If historic properties cannot be avoided, they must be mitigated.

The demands of recent heightened federal minerals production has created, and will continue to create, impacts to cultural resources. BLM archeologists often perform pre-approval field checks of contracted Class III inventories, but are primarily focused on the project footprint and are unable to adequately verify the accuracy of large block inventories. Therefore, it is not clear if the contracted inventories are adequately locating all cultural resources. The emphasis on report review and permitting does not allow BLM archeological personnel the time to adequately perform post-approval duties. Although post-approval site monitoring is rare in the planning area, many sites in developed areas appear to have been subject to unauthorized collection or vandalism. Protective measures are often required as COAs for federal undertakings, but it is not clear if those measures are adequately implemented.

3.5.1.5. Key Features

There are numerous archeological sites throughout the planning area that are key features. Site types range from prehistoric sites that are significant for their scientific value, historic structures or the locations of significant historic events, and sacred sites significant to Native American tribes. There are undoubtedly undiscovered significant sites throughout the planning area, but the following known sites necessitate special management considerations.

Prehistoric sites

1. Buried sites:
   - Sisters Hill Site
   - Carter-Kerr-McGee Site
   - Ruby Site
   - Piney Creek Site
   - Big Goose Site

- Cordero Mine Site
- Mavrakis-Bentzen-Roberts Site
- Powder River Site, Mooney Site

2. Rockshelters:
   - Schiffer Cave Site
   - Grey-Taylor Site
   - Sweem-Taylor Site

Historic Sites

1. Forts and Ranches:
   - Cantonment Reno
   - Fort Reno
   - LX Bar Ranch
   - K Ranch, Sievers Ranch
2. Trails:
   - Bozeman Trail
   - Deadwood Trail
   - Sawyers Expedition Route
   - Crook Scout Route
   - Black and Yellow Trail
   - Texas Trail
3. Battle Sites:
   - Dull Knife Battle
   - Crazy Woman Battle
   - Tongue River Fight Site

Sacred Sites

1. TCPs:
   - Pumpkin Buttes
2. Rock Art
3. Stone Circle and Cairn Sites

Areas With a High Potential for Buried Cultural Resources

Areas with a high potential for buried cultural resources are key features that should be considered during the planning process. Buried archeological sites are very difficult to locate during a standard Class III inventory and during earth moving construction activities. Given the potential for significant buried sites and the difficulty in locating those sites, such areas necessitate special management considerations.

South Big Horn Mountains

The 1985 RMP necessitated the creation of the Cultural Resources Management Plan for the Outlaw Cave Archeological District. Limited inventory indicated a high density of significant sites (rockshelters, rock art, and stratified buried sites) near Outlaw Cave and in the drainage of the Middle Fork Powder River. The density of significant sites reported in this early inventory is undoubtedly not limited to that specific area. Recent data indicates the entire Southern Big Horn Mountain Subregion contains the same high density of significant sites. Given the density of significant sites and the limited amount of research in the subregion, the general area necessitates special management considerations.

3.5.2. Paleontological Resources

Paleontological Resources are any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth. Scientifically significant paleontological resources (including vertebrate, invertebrate, plant, and trace fossils) are known to occur in many of the geologic formations within the Wyoming PRB. These paleontological resources are documented in the scientific literature, in museum records, and are known by paleontologists and land managers familiar with the area. It has been determined that paleontological resources on federal land shall be managed and protected using scientific principles and expertise. Appropriate plans for the inventory, monitoring, and the scientific and educational use of these resources shall be developed, in accordance with applicable agency laws, regulations, and policies, These plans shall emphasize interagency coordination and collaborative efforts where possible with non-federal partners, the scientific community, and the general public.

All paleontological resources offer scientific information, but not all fossils offer noteworthy scientific information. Fossils generally are considered to be scientifically noteworthy if they are unique, unusual, rare, diagnostically or stratigraphically important, or add to the existing body of knowledge in a specific area of science. Most paleontological resources occur in sedimentary rock formations. Although experienced paleontologists generally can predict which formations may contain fossils and what types of fossils may be found based on the age of the formation and its depositional environment, predicting the exact location where fossils may be found is not possible.

3.5.2.1. Regional Context

Geologic formations are the basic units of stratigraphy. A formation consists of a certain number of rock strata that have a comparable lithology, facies or other similar properties. Paleontological resources are closely tied to the geologic formations in which they are present; different-aged rocks contain different types of fossils. Almost all of the geologic formations in the planning area have the potential to produce significant paleontological resources. There are known fossil localities scattered throughout the planning area that have produced a variety of important fossils from the six Class 5 formations, as well as others, so there is a potential for additional significant discoveries to be made. Formations known to produce important vertebrate remains in the planning area include the Chugwater, Sundance, Morrison, Cloverly, Lance, Fort Union, Wasatch and White River formations. Many of the fossil-bearing formations within Wyoming are in the planning area, but they are not extensively distributed or substantially exposed at the surface.

Management of fossils found on BLM-administered lands is restricted to public surface. Collecting fossils is allowed with some restrictions, depending on the significance of the fossils. Hobby collecting of common invertebrate or plant fossils by the public is allowed in reasonable quantities when only hand tools are used and negligible disturbance is made. Commercial collecting of fossils is not permitted. Collection of all vertebrate and any administratively designated plant or invertebrate fossils may be done only under permits issued by the BLM to qualified researchers. All fossils collected under a permit remain public property and must be curated in an approved repository.

The BLM utilizes the Potential Fossil Yield Classification (PFYC) system to classify the potential to discover or impact significant paleontological resources. PFYC is based on the likelihood of geologic formations to contain significant paleontological resources using a scale of 1 (very low potential) to 5 (very high potential). The PFYC is intended to help determine proper management and mitigation approaches for surface-disturbing activities, disposal or acquisition actions, recreation possibilities or limitations, and other BLM-approved activities, with more intense mitigation efforts aimed at higher-potential formations. The system also can highlight areas likely to be a focus of paleontological research efforts or illegal collecting.

3.5.2.2. Indicators

The primary resource indicator for paleontological resources is the degree of loss of characteristics that make fossils or fossil localities important for scientific and educational use or public enjoyment. Damage or destruction of the fossils themselves, impacts to the natural setting of the fossils, poorly executed molding or casting, or disassociation of related fossils all can contribute to a loss of scientific information or public use of the resource. Natural or accelerated erosion, decay of the fossils, project construction, improper collection, and vandalism can remove, alter, or damage the characteristics that make the paleontological resource scientifically important or enjoyable for the public.

3.5.2.3. Current Condition

Exposure of bedrock is necessary to find fossils, and these exposures are limited in the planning area due to the generally rolling, soil-covered, and well-vegetated landscape. Although most of the formations in the planning area contain fossils, relatively few fossil localities are recorded. Documentation of fossils depends on the number of researchers and others looking for fossils. Out of 53 current BLM paleontological research permits, 12 include some type of focus on the planning area. Only two researchers are specifically focused on paleontological resources in the planning area. Even though there appears to be low academic interest at the current time, there is still a high likelihood that undocumented significant fossils are present in the planning area.

Scattered occurrences of vertebrate fossils, leaf impressions and invertebrate marine fossils are known in the planning area. The most easily identified fossil in the planning area is petrified wood from the Wasatch Formation, sometimes found as large log segments or rarely as upright stumps. The Dry Creek Petrified Tree EEA (40 acres) near Buffalo contains fossilized trees and stumps preserved in upright positions and fallen logs. The BLM has developed the location with interpretive signs and walkways to provide an educational area. An NSO stipulation has been applied to the site to restrict any surface disturbances.

Mitigation efforts aimed at identifying and protecting paleontological resources are being applied to energy development activities, major pipelines, and road and other construction actions. These efforts are focused on areas anticipated to commonly contain significant fossils. While it is likely that there is some hobby collecting of fossils the planning area, there is no data relating levels of use. Similarly, there is no documentation of illegal fossil collecting in the planning area.

The potential for impacts to scientifically significant paleontological resources are predicted to be greatest in areas where PFYC Class 4 or 5 (High or Very High) formations are present. In addition, in most cases those rock units with a PFYC of 3 (Moderate or Unknown) will require some management decision and action. Class 3 formations are fossiliferous units where fossil content varies in significance, abundance, and predictable occurrence; or of unknown fossil potential. Surface-disturbing activities will require sufficient assessment to determine whether significant paleontological resources occur in the area of a proposed action, and whether that action could affect the paleontological resources.

The Wasatch Formation is the most geographically widespread unit exposed on the surface over most of the planning area. It is underlain by the Fort Union Formation. The fossiliferous Morrison and Lance formations crop out along the margins of the PRB and occur at depth in the vicinity of the coal mines. The highly fossiliferous White River Formation occurs only on Pumpkin Buttes in southwestern Campbell County.

In recent years, the Wasatch Formation has been downgraded to a Class 3a formation (geologic units with widely scattered scientifically significant fossils) in the PRB, but remains a Class 5 formation (highest rating) statewide. The Fort Union Formation has been proposed to be upgraded from a Class 3 (geologic units where fossil content varies in significance, abundance, and predictable occurrence; or of unknown fossil potential) to a Class 4 formation (geologic units containing a high occurrence of scientifically significant fossils) statewide.

Currently there are six geologic formations in the field office that have a PFYC rating of 5 (Table 3.40, “Formations Containing Very High Fossil Yield Classifications” (p. 402)). These formations total 230,182 acres or approximately three percent of the entire planning area. A total of 28,177 acres with a PFYC rating of 5 occur on BLM surface (3.6%). However, as the Potential Fossil Yield Classifications for rock units in Wyoming is under revision, these numbers will change in the near future.

Table 3.40. Formations Containing Very High Fossil Yield Classifications

Formation	Age	Potential Fossil Yield Classification
White River Formation	Oligocene Epoch, Tertiary Period – approximately 38 to 30 million years ago	5
Moncrief and Kingsbury Conglomerate Members of the Wasatch Formation	Eocene Epoch, Tertiary Period – approximately 55 to 38 million years ago	5
Lance Formation	Cretaceous Period – approximately 70 to 65 million years ago	5
Cloverly Formation	Cretaceous Period – approximately 138 to 100 million years ago	5
Morrison Formation	Jurassic Period – approximately 142 to 138 million years ago	5
Sundance Formation	Jurassic Period – approximately 170 to 142 million years ago	5
Source: Love et al. 1993		

White River Formation

The Middle Tertiary White River Formation consists of bentonitic mudstone, sandstone, and altered or unaltered volcanic debris. Thousands of vertebrate fossils have been collected from this rock unit, including mammals, reptiles, amphibians, fish, and birds, as well as trace fossils. This formation is found throughout the Northern Great Plains and forms the landscape preserved at Badlands National Park in South Dakota. The only occurrence of this geologic formation in the planning area is the sandstone caps forming the tops of Pumpkin Buttes. Vertebrate fossils, including mammal bones from this formation have been located in the planning area.

Moncrief and Kingsbury Conglomerate Members of the Wasatch Formation

The Lower Tertiary Wasatch Formation in eastern Wyoming consists of sandstone and variegated claystone with numerous coalbeds in the lower portions (Love and Christiansen 1985). In the western Powder River Basin the Wasatch Formation includes the Moncrief Member (a conglomerate of Precambrian clasts, interbedded with sandstone and claystone) and the Kingsbury Conglomerate (a conglomerate of Paleozoic clasts, interbedded with sandstone and variegated claystone) (Love and Christiansen 1985). In southwestern Wyoming the Wasatch Formation contains numerous mammal, amphibian, bird, and reptile fossils, including trace fossils. Wasatch Formation deposits underlie the majority of the planning area, and occasionally contain fossil bones. Reptile and mammal fossils are sporadically found throughout the basin, and some very rich fossil localities are known from this unit near the towns of Sussex and Lynch. Some nearly complete large fossil mammals have been found in the upper parts of the formation. Researchers have also collected small vertebrate fossils, including mammal bones, primarily from anthills in the Wasatch Formation.

Lance Formation

The Upper Cretaceous Lance Formation is dominated by nonmarine coastal floodplain sandstones, mudstones, and marls, with marginal marine sandstones and shales in its lower parts. It reaches more than 750 meters in thickness and is found in many places throughout Wyoming. The formation can contain a diverse fauna from the end of the Mesozoic Era including tyrannosaurs and other theropods, ankylosaurs, hadrosaurs and other ornithopods, ceratopsians, and pachycephalosaurs, and pterosaurs, as well as a variety of mammals, reptiles, amphibians birds, and fish. Important track sites are also known. A relatively small portion of the formation is exposed along the margins of the planning area. There are no known fossil discoveries from the geologic unit in the planning area, although there have been numerous significant finds between Lusk and Newcastle.

Cloverly Formation

The Lower Cretaceous Cloverly Formation was deposited under floodplain and lacustrine conditions, having an average thickness of approximately 90 meters. The formation primarily has variegated claystones with channel-filling sandstones and conglomeratic sandstones. Above the zone of conglomerates and conglomeratic sandstones at the base of the Lower Cretaceous, the shales and sandstones are buff and gray with purple, maroon, and red shales in the middle. The Cloverly Formation has produced a diverse dinosaur fauna in Montana and the Bighorn Basin of Wyoming including iguanodonts and other ornithopods, sauropods, theropods, and ankylosaurs as well as lizards, turtles, fish, and early mammals. Dinosaur eggs have also been found in this unit. Small portions of the formation are exposed in the foothills of the Big Horn Mountains in the planning area, although no significant finds have been documented.

Morrison Formation

The Upper Jurassic Morrison Formation was deposited under floodplain and lacustrine conditions and can be up to 65-meters thick. It consists of green and greenish-gray shale and claystone with lenticular silty sandstones and occasional conglomerates, thin carbonaceous beds, freshwater marls, and limestone lenses characteristic of floodplain and lake deposits. The Morrison Formation is well known for producing a scientifically noteworthy and highly diverse fauna and flora. In

Wyoming this fauna includes allosaurids and other theropods, diplodocids and camarasaurids, stegosaurs, ornithopods, ankylosaurs, and pterosaurs, as well as variety of mollusks, reptiles, amphibians, fish, early mammals, and trace fossils. This formation is found throughout the Rocky Mountain area and is noted for fossil deposits at Dinosaur National Monument in Utah, Como Bluff in Wyoming, Dinosaur Ridge in Colorado, and other world-class sites. Small portions of the formation are exposed in the foothills of the Big Horn Mountains in the planning area and important discoveries have been (and continue to be) made there since the late 1800s.

Sundance Formation

The Middle-Upper Jurassic Sundance Formation consists of marine sandstones, limestones, and shales deposited in an inland sea or adjacent near-shore and beach deposits from the latter part of the Jurassic Period. The formation varies in thickness from 75 to 130 meters. It consists of greenish-gray glauconitic mudstones and shales with some interbedded sandstones and limestones containing many invertebrate fossils, including clams and oysters, crinoids (sea lilies), echinoids (sea urchins), and belemnites (squid-like animals). Marine reptiles including ichthyosaur, and plesiosaur specimens are also found this formation. A rich trace fossil record is recorded in this unit ranging from a diversity of invertebrate traces to pterosaur and theropod dinosaur footprints. Small portions of the formation are exposed in the foothills of the Big Horn Mountains in the planning area, although no significant finds have been documented.

3.5.2.4. Trends

Given the limited number of localities, monitoring data and the minimal amount of paleontological research in the planning area it is difficult to identify trends. It can be assumed that any surface-disturbing activities in areas with a PFYC of 5 have the potential to destroy significant fossils. Although, the majority of foreseeable development considered in this plan is not in these areas.

However, as most of the geologic formations in the planning area have the potential to produce significant paleontological resources and there are known fossil localities scattered throughout the planning area, there is a potential for additional significant discoveries to be made. Future research and mitigation efforts could discover significant paleontological resources, which could require special management to protect or develop them.

However, the absence of localities in the PRB does not always mean that scientifically significant fossils are not present, as much of the area within and surrounding the PRB has not been adequately explored for paleontological resources. As a result, development activities in the planning area have the potential to adversely affect scientifically significant fossils, if they are present in or adjacent to disturbance areas.

The greatest potential impact on surface and subsurface paleontological resources would result from disturbance of surface sediments and shallow bedrock during construction and/or operations, depending on the type of project. Potential subsurface disturbance of paleontological resources (e.g., during drilling operations) would not be visible or verifiable. However, as only portions of the planning area have been evaluated for the occurrence of paleontological resources, and discrete locations for development activities cannot be determined at this time, no accurate estimate can be made as to the number of paleontological sites that may be affected by cumulative development activities. Development activities which involve federally owned surface and/or minerals are subject to federal guidelines and regulations protecting paleontological resources.

Protection measures, permit COAs, and/or mitigation measures would be determined on a project specific basis at the time of permitting to minimize potential impacts on paleontological resources as a result of these activities.

3.5.2.5. Key Features

Geologic formations with a very high (Class 5) potential to produce significant paleontological resources currently include the White River Formation, the Moncrief and Kingsbury Conglomerate Members of the Wasatch Formation, and the Lance, Cloverly, Morrison, and Sundance Formations. These geologic formations amount to approximately 230,182 acres or approximately three percent of the entire planning area; on BLM surface, they total approximately 28,177 acres or approximately 3.6%. Due to the fact that these formations have a very high potential to contain significant fossils, they are key features.

In addition, unique examples of large intact logs and upright stumps of petrified wood fossils preserved in the Wasatch Formation are the most widespread important fossils in the planning area. The Dry Creek Petrified Tree EEA is an outstanding example of this resource and is a key feature.

3.5.3. Visual Resources

To meet its responsibility to maintain the scenic values of public lands, the BLM has developed a VRM system that addresses the following:

- Every landscape has the basic elements of form, line, color, and texture. Repeating these elements reduces contrasts between the landscape and the proposed activity or development and results in less impact to visual resources.
- Different levels of scenic values require different levels of management. For example, management of an area with high scenic value might be focused on preserving the existing character of the landscape, and management of an area with little scenic value might allow for major modifications to the landscape. Determining how an area should be managed first requires an assessment of the area's scenic values.
- Assessing scenic values and determining impacts to visual resources can be a subjective process. Objectivity and consistency can be greatly increased by using the basic design elements of form, line, color, and texture, which have often been used to describe and evaluate landscapes, to also describe proposed projects. Projects that repeat these design elements are usually in harmony with their surroundings; those that do not create contrast. Adjusting project designs so the elements are repeated can minimize impacts to visual resources.

The VRM system provides a way to identify and evaluate scenic values to determine the appropriate levels of management. It also provides a way to analyze potential impacts to visual resources and apply visual design techniques to ensure that surface-disturbing activities harmonize with their surroundings. The BLM VRM system consists of two stages – (1) Visual Resource Inventory (VRI) and the designation of VRM Classes during the resource management planning process; and (2) implementation of RMP decisions and analysis through the Visual Resource Contrast Rating (VCR). The inventory stage, performed in the planning area in July 2009, identifies the visual resources of an area and assigns them to inventory classes. The process involves rating the visual appeal of a tract of land, measuring public concern for scenic quality, and determining whether the tract of land is visible from travel routes or observation points (BLM 1986a). The results of the VRI and visual sensitivity are considered throughout the RMP process, and the areas' visual resources are assigned to management classes with established objectives.

3.5.3.1. Regional Context

The planning area is divided into four VRM classes based on different objectives. The degree of visual modifications allowed is specific for each VRM class. The goal of VRM, however, is to minimize the visual impacts of all surface-disturbing activities regardless of the class in which they occur. The *Glossary* summarizes the objectives for VRM classes. Formerly, VRM included an additional class (Class V) that identified areas where the landscape character has been so disturbed that rehabilitation is needed.

3.5.3.2. Indicators

The indicator for visual resources is the loss or addition of aesthetic values. While assessing scenic values and determining visual impacts can be a subjective process, the objectivity and consistency of analysis can be greatly increased by using the basic design elements of form, line, color, and texture to evaluate landscapes and project proposals. Proposed projects that would repeat the natural design elements are usually in harmony with their surroundings; those that do not create contrast. The design elements assist in determining an area's VRI class and the practicality for management of a particular VRM class.

3.5.3.3. Current Condition

Visual resources in the planning area vary widely, from mountains and foothills in the western portion to low rolling prairie in the east. The large areas of undisturbed sagebrush-grasslands and mountain foothills in the planning area are unique compared to the more densely populated Great Plains regions to the east and south.

Almost 60% of the planning area is in the Powder River Basin ecoregion (EPA 2004b). This region includes gently rolling to steep dissected plains and wide belts of steeply sloping badlands that border the Powder and Tongue river valleys. In places, flat-topped, steep-sided buttes rise sharply above the surrounding plains, such as Pumpkin Buttes in the southeast part of the planning area. The vegetation is primarily sagebrush and grassland, with patches of pine-juniper woodland.

The foothill shrublands and low mountains ecoregion of the Wyoming Basin is the second largest region represented on BLM-administered surface in the planning area (approximately 14%). It is in the southwest part of the planning area in the foothills of the Big Horn Mountains. The vegetation is shrub steppe, desert shrubland, and pine-juniper woodland. The Chugwater Formation, with its striking crimson color and steep vertical escarpments, is prominent in the southern foothills of the Big Horn Mountains. In addition, Powder River tributaries cut deep vertical canyons in the foothills of the Big Horn Mountains, and then break out into broad riparian zones that provide visual diversity across the grasslands of southern Johnson and Campbell counties.

Visual Intrusions

Impacts to visual resources from human disturbance were relatively minor before mineral development under current management. Oil and gas development, particularly CBNG, has resulted in the most widespread impacts to visual resources in the Powder River Basin. Long-term disturbance to visual resources has occurred with the construction of well pads, access roads, overhead powerlines, water-handling facilities, central metering facilities, and compressor stations. Increased night lighting at facilities has introduced intrusive and potentially undesirable elements into the visual landscape. Visibility has been affected by fugitive dust emissions and exhaust from vehicles and production facilities. Natural disturbances have been principally fire and drought. Coal mining has had the most intensive impact on visual resources in the portions of the planning area affected by coal mining. During the life of a coal mine, substantial changes to line, form, color and texture occur on a local level.

In VRM Class II areas along major transportation routes, facilities constructed on state and private surface that were not part of a federal action have resulted in substantial impacts to visual resources in the area and eroded the usefulness of mitigation measures implemented on federal surface. As of April, 2012, there were approximately 1,025 active oil and gas wells in VRM Class II areas, mainly along Interstate 90, U.S. Highway 14/16, and near the Tongue River. Of these, 645 (63%) were non-federal actions. Surface-disturbing activities associated with these facilities are easy to notice because of the amount of contrast with the representative landscapes. Additionally, across the planning area the extraction of other minerals such as bentonite, uranium, sand, and gravel often includes a substantial change in the line, color, and form of the existing landscape, which increases with the scale of the operation.

Visual Resource Management within the Planning Area

The predominant VRM classes in the planning area are Classes III and IV, which comprise approximately 80% of the total area (Map 41). Some scenic areas are managed as VRM Class II, including the Bighorn National Forest and the foothills of the Big Horn Mountains, the Tongue River east of Interstate 90, State Highway 336 in the vicinity of Wyarno, U.S. Highway 14 and Interstate 90 in the vicinity of the Powder River, and Interstate 90 between Rozet and Wyodak. The majority of the Fortification Creek area is designated VRM Class III. Only approximately one percent of the area is rated as Class V, primarily in the vicinity of coal mines and densely populated areas. The VRM system no longer recognizes Class V management areas. As reclamation in previously designated Class V areas has yet to take place, the areas are generally managed as VRM Class IV. The 1985 RMP and subsequent amendments or updates did not formally designate areas as Class I, as shown in Table 3.41, "Visual Resource Management Classes" (p. 408). However, WSAs and the portion of the Middle Fork Powder River corridor that is suitable and eligible for WSR designation are currently managed as VRM Class I (BLM 2000b).

The three WSAs have been withdrawn from mineral entry and are closed to leasing. Under current management, any facilities or structures proposed in or near WSAs must be designed so as not to impair wilderness suitability. Outside of WSAs, no activity or occupancy is allowed within 200 feet of the edge of state and federal highways. Facilities or structures such as powerlines, oil wells, and storage tanks are required to be screened, painted, and designed to blend with the surrounding landscape except where safety dictates otherwise.

Table 3.41. Visual Resource Management Classes

VRM Class	BLM Surface Acres
Class I[1]	30,101
Class II	127,594
Class III	63,717
Class IV	559,674
Class V	702

Source: BLM 2012f

[1] The three WSAs and Middle Fork Powder River WSR were not originally designated as VRM Class 1, but are managed as such. The acreage for the Fortification Creek WSA (12,419) was subtracted from VRM Class III and the acreage for the remaining WSAs and Middle Fork Powder River WSR (17,984) was subtracted from VRM Class II.

BLM Bureau of Land Management
WSA Wilderness study Area
WSR Wild and Scenic River
VRM Visual Resource Management

3.5.3.4. Trends

The widespread development of mineral resources in the planning area has created direct, adverse visual impacts. Mitigation of this activity has largely prevented mineral development activities from exceeding the established VRM class objectives. However, the trend toward continued expansion of natural resource development could create areas of potential conflict between resource uses and the established VRM class objectives.

The number of completed wells in the planning area has averaged more than 1,000 per year since 2004. However, the number of plugged wells has been substantially less, approximately 230 per year over the past 15 years. Exceptions for development within 200 feet of highway corridors have been granted by the Federal Highway Administration, creating notable contrasts to the existing landscape along the I-90 corridor. Oil and gas facilities constructed on private surface that were not part of a federal action have resulted in impacts to the viewshed, despite mitigation measures implemented on federal surface. These non-BLM actions have resulted in major impacts to visual resources in Class II areas along Interstate 90 and U.S. Highway 14 near the Powder River. Extraction activities for other minerals (such as bentonite, sand, and gravel) have contributed to visual resource degradation at a site-specific level. However, many recent applications for mining of these minerals have been for areas either adjacent to, or very near, existing mining operations, and therefore tends to minimize overall degradation by concentrating it in areas already degraded.

Renewable energy projects such as solar panels or wind farms have not yet been constructed in the planning area, although at least one project has been proposed on fee surface adjacent to BLM-administered lands. Renewable energy project proposals are expected to increase as traditional energy sources are depleted and the economic and political incentives for alternative energy sources increases.

Recreational use, most specifically OHV use, has adversely affected visual resources by damaging vegetation and increasing erosion, especially in riparian areas or on hillclimbs. Enforcement of OHV regulations in the planning area was minimal before 2008, resulting in resource damage, including visual resource impairment. The presence of law enforcement personnel since 2008 has reduced or mitigated the number of OHV incidents in the planning area.

Visual intrusions normally associated with smaller projects would result in fewer impacts to visual resources. Contrasts in the basic elements are generally moderate and most of these projects remain subordinate to the representative landscape. These projects include a wide variety of range improvements, fuel-reduction projects, and two-track roads throughout the planning area.

3.5.3.5. Key Features

The following visually sensitive areas have been identified to help guide land use management decisions.

Unique Visual Landscapes

The Big Horn Mountains and foothills form the western boundary of the planning area and dominate the view from many observation points to the east. River canyons cutting through a variety of geologic formations interrupt the foothills, creating dramatic shapes along the eastern slope of the Big Horn Mountains.

The Middle Fork Powder River is in the southwest portion of the planning area. It includes steep incised canyons, ranging in elevation from 5,000 to more than 8,000 feet. It is a popular recreation area, frequented by fishermen, hikers, and history buffs. Outlaw Cave is in Middle Fork Canyon.

The Red Wall, east of the Middle Fork Powder River, is a unique geologic formation running north to south along the foothills of the Big Horn Mountains. It is characterized by its steep cliffs and red stone of the Chugwater Formation. The Middle Fork Powder River and its tributaries run in the valley between the Red Wall and the Big Horn Mountains, creating a picturesque riparian corridor. The Hole-in-the-Wall historic site is on the southern end of the Red Wall on BLM surface.

Two WSAs, Gardner Mountain and North Fork, are in the Big Horn Mountain foothills, also in the southwest part of the planning area. They are approximately 5 miles apart in a very remote portion of the mountains. The Red Fork Powder River runs through the Gardner Mountain WSA and the North Fork Powder River bisects the North Fork WSA. The scenic rugged canyons and rock outcrops have prevented much development in the region apart from isolated range facilities, small mines and historic forestry actions.

There is a third visually unique WSA in the north-central portion of the planning area. Fortification Creek WSA is east of the Powder River and is dominated by steep draws, erosive soils, and a mosaic of vegetative types. It includes juniper-ponderosa pine woodland patches that provide cover for a resident elk herd.

Primary Visual Corridors

The planning area is divided by two interstate highways – Interstate 90, which runs primarily east-west through the Powder River Basin and then north to the Montana State line, and Interstate 25, which runs north-south along the Big Horn Mountains to its intersection with Interstate 90. Interstate 90 is a major transportation highway across the northern tier of the United States and is one of the main vacation routes between the Black Hills of South Dakota and Yellowstone National Park.

The U.S. Highway 14/16 corridor runs east-west across the northern portion of the Powder River Basin. It is an alternative route through the Big Horn Mountains, following riparian valleys for approximately half its distance across the planning area.

U.S. Highway 59 runs north-south along the eastern side of the planning area. It is a main industrial transportation route between Gillette and Douglas to the south. The northern portion of the route, between Gillette and the Montana State line, is largely undeveloped.

Several rivers offer opportunities for recreation, especially fishing, including Clear Creek, Crazy Woman Creek, the Tongue River, and all forks of the Powder River. The Tongue River in Sheridan County is also a popular destination for boaters and float trips throughout summer months. The Middle Fork Powder River is a blue ribbon trout stream and one of the most popular destinations for anglers in the planning area.

Historic properties are also particularly susceptible to visual impacts. Areas of notable concern for visual impacts to the cultural setting include the Pumpkin Buttes TCP, the Bozeman Trail and historic forts and battlefield sites. Visual intrusions in these locations can greatly affect visitor experience and the integrity of areas where viewshed is integral to historical significance.

3.6. Land Resources

3.6.1. Forest Products

3.6.1.1. Regional Context

The planning area lies on the east side of the Big Horn Mountains and extends into the Powder River Basin. The ecoregions for the forest lands are the Granite Subalpine Zone, the Dry Mid-Elevation Sedimentary Mountains, and the Pryor Bighorn Foothills. There are seven major forest management units and smaller units that are scattered tracts from the north end of the planning area west of Sheridan, Wyoming, on the Red Grade Road and. larger contiguous tracts that extend from Mosier Gulch to the Hole-in-the-Wall campground in the South Big Horns. The geographical area includes the Billy Creek forest management area at the North end of Hazelton Road on the east facing slopes of the Big Horns, the Powder River Management Area, Hazelton Road Management Area, the Horn, Bear Trap Management Area, Garden Mountain Management Area, and the Graves Corral Management Area on the southern end.

There are scattered woodlands throughout the tri-county area with concentrations of woodlands in Campbell and Johnson counties. They are concentrated in the Pine Scoria Hills, the Casper Arch, the Mesic Dissected Plains, and the Powder River Basin Ecoregions. The woodlands in Campbell County, extend from Dead Horse Creek to Bitter Creek on the Montana border, on the east side from Homestead Draw to Horse Creek, and in the southeast from Corral Creek to 7 Prong Creek. The woodlands extend on the east side of the south Big Horns to the Middle Fork Powder River in Johnson County.

3.6.1.2. Indicators

The fundamental indicators are those that recognize a connection between the forest and the people. The only way to achieve the sustainability of the forest and therefore the forest products is to have the understanding and support of the people.

- In order to ensure the productivity of the forest and woodlands for forest products they need to be available for timber production and management.
- The forest and woodlands need to managed for ecosystem health.
- The production and removal of the forest products should compare to sustainable harvest levels.
- The resources that play a role in the forest and woodland health, such as soil and water should be conserved and maintained.
- Representation of multiple tree species and genetic variation within the species, and multiple age classes, to support diversity and a multitude of products, concentrating on commercially desirable tree species.
- Support and maintenance of the socioeconomics of the community and society.
- The political framework and support for the forest industry.

3.6.1.3. Current Condition

The Buffalo Field Office administers 77,229 acres of forests and woodlands. Forests and woodlands are distinguished by type (species composition) and the physical environment in which they grow. Approximately 95% of the volume removed was utilized for forest products, with post and poles being the largest component of removals from the growing stock, followed by sawlogs and fuelwood. The remaining 5% was left in the woods.

Worldwide, fuelwood has taken the lead in forest uses with over 1.8% of the wood being utilized in this capacity. The forest products removed in this area have followed suit, as the mills that once utilized and dispensed the forest products have declined.

Approximately, 5 to 10 mbf per acre is planned to be commercially available annually, with these volumes increasing or decreasing with the economy and opportunities, and natural occurrences.

Active timber sales within the area will continue, primarily in lodgepole and Douglas fir. The areas harvested in the past have successful natural regeneration in the openings and provide species and age class diversity. These future stands will require thinning and other silvicultural manipulations to reduce the density and promote healthy stands. The sale and removal of the forest products has been focused on salvage harvest for the sawlogs and Timber Stand Improvement, especially for the post and poles, to create healthy and resistant forest.

3.6.1.4. Trends

Timber processing capacity has steadily declined over the past two decades within the planning area, as well as west wide. In the interior west, the restricted availability of the timber is the result of several restrictions such as appeals and litigation, Threatened and Endangered species protection, changing environmental laws, and the changing expectations of the public.

The integration of the timber industry into the global markets has introduced significant competition worldwide and has driven down the prices of forest products. The recent recession is the worst in 25 years for the forest products industry.

The development of new forest products such as wood pellets, biofuels, and biomass has not gained substantial traction within the region; most of the new development of these alternative products has been concentrated in the Southeast and the Northwest portions of the U.S.

As a result of fire suppression and the reduction in harvesting activities, forests with commercial potential are in need of active management to increase their economic suitability. However, the increased utilization of fuelwood aids in manipulating the increased amount of fuels in the forest and reducing the density of forest and woodland stands to support the diversity of age and species distribution.

The public demand for fuelwood, post and piles and other special forest products, such as Christmas trees has remained strong and is anticipated to increase as the population of the planning area increases.

3.6.1.5. Key Features

The key feature of the forest products program is the flexibility that the forest presents in providing the desirable products to the communities and the ability to manipulate the forest/woodlands in producing these products while providing for all the other resources including watersheds, wildlife, and recreation. The products are allocated in response to the economics of the communities.

A prized characteristic of forest and woodlands is that they are renewable resources. Therefore, products utilized by society and in particular this community are able to be replaced. Successful regeneration of the forest is and has been a valuable asset in replacing vegetation and replenishing the watersheds of the Big Horn Mountains.

The other type of product provided by the forest and woodlands, is a product that cannot be measured. The set aside value for the spiritual, recreational, tourist, educational, and conservation values.

3.6.2. Lands and Realty

Lands and realty management supports all resources and resource management programs. The primary focus activities of the program are land use authorizations for ROW and corridor management associated with oil and gas development. Secondary activities include land tenure adjustments such as sales, exchanges, donations, acquisitions (including easements); leases and sales under the Recreation & Public Purposes Act; withdrawals; classifications and other segregations, various land use authorizations; and trespass identification and abatement.

3.6.2.1. Regional Context

FLPMA is the primary statute governing public land management and is the primary authority for activities within the lands program. Specific BLM Wyoming objectives include the following:

- Avoid trespass and improve access and manageability of public lands
- Support multiple-use management goals among the various resource programs
- Respond to public requests for land use authorizations, sales and exchanges, and to acquire access to serve administrative and public needs
- Consideration of Recreation and Public Purposes (R&PP) applications that do not exhibit conflicting uses
- Support management of other resource programs and other federal agencies regarding withdrawals

3.6.2.2. Indicators

Indicators for management for success in the Lands and Realty program would include the number of actions and acreage size of land use authorizations such as leases, permits, easements, land tenure adjustments, withdrawals, classifications, and segregations. For example, the number and acreage of access easements acquired and the total acreage that becomes legal public access from the acquired easements.

3.6.2.3. Current Condition

The BLM currently manages approximately 10% of the surface in the planning area. The general land ownership pattern in the planning area consists of some large blocks of BLM-administered public lands interspersed with many isolated, small-acreage parcels which are difficult or impossible to access or manage.

The Buffalo Field Office identifies approximately 117,427 acres as more difficult or less economic to manage than most of the BLM-administered public lands in the planning area. These lands have priority consideration for disposal through exchange, public sale, or transfer of jurisdiction to another agency.

Leases, Permits, and Easements

Land use authorizations under FLPMA section 302 (b) authorizes the BLM to use, occupancy, and development of the public lands through leases, permits, and easements of those public lands. CFR Title 43 Part 2920 provides the appropriate regulations and guidance for these authorizations. Easement acquisitions are an integral part of management.

Since 1985, the Buffalo Field Office has acquired 24 easements on non-federal lands for improved access and public land management. The Buffalo Field Office acquired easements in the Poison Creek, Dry Creek Petrified Tree, and Outlaw Cave areas. These lands involve a total of approximately 96 acres.

Land Tenure Adjustments

The land ownership pattern in the planning area is diverse, a large portion of scattered parcels that are isolated by large private landholdings. This scattered isolated ownership pattern makes these lands difficult and economically inefficient to manage as part of the public land system. The small size of many scattered parcels and their isolation from other parcels of public land make them of marginal utility to the public. Lack of legal public access diminishes their public utility. The existing plan prioritizes exchanges and acquisitions on lands adjacent to large blocks of public lands. Some area of exceptions occur, north of Gillette (Cow Creek Breaks area), the eastern flank and south to southwest Johnson county areas, where larger parcels are present.

Land ownership (or land tenure) adjustment refers to those actions that result in the retention of public land, disposal of public land, or the acquisition by the BLM of non-federal lands or interest in land. Land tenure adjustment is used to increase access and manageability of public lands, particularly those with high-value resources. Special legislation often governs land program activities in a particular management area, or directs acquisition or disposal of specific lands. Private legislation can also direct land tenure adjustments.

Management recognizes the potential retention of lands where there are archeological, historic, wildlife, or other values. Conversely, small parcels included in a large federal grazing allotment are generally efficient to manage and should be retained. Lands identified for disposal are typically small, isolated tracts that are difficult and economically inefficient to manage. Lands designated in the BLM land use plan as potentially available for disposal are more likely to be conveyed out of federal ownership through an exchange rather than a sale. This preference toward exchange over sale is established in BLM's policy.

Retaining isolated land parcels in public ownership remains a management liability because they are difficult to access and uneconomic to manage with the potential for trespass results in unnecessary management costs to abate and mitigate. In most cases, these lands provide little or no utility to the public because of limited or lack of legal access, and the average size of individual parcels is too small to afford a viable recreation or other outdoor experience.

Historically, many isolated public land parcels were difficult to access and manage appropriately. Although the Buffalo Field Office acquired approximately 24 easements for access and range management, the overall condition remains – small isolated parcels with limited or no access are difficult to manage due to increased potential for conflicts with adjacent landowners, inadvertent and willful trespass, and other uses difficult to monitor and control.

Land Sales (FLPMA Section 203)

Conducting land sales requires either offering a direct sale to relevant landowners, which could include the state in which the lands are located, the local government entity in the state, adjoining landowners, individuals, or any other person. FLPMA states that, "the United States receive fair market value of the use of public lands and their resources unless otherwise provided for by statute" (FLPMA section 102(9)). Competitive sale of lands is required unless the Secretary of the Interior determines a necessity to dispose of lands through modified competitive bidding or without competitive bidding.

To be considered for disposal, lands must, at a minimum, meet the following criteria as outlined in Section 203 of the FLPMA: (1) They are difficult and uneconomical to manage, and are not suitable for management by another federal department or agency, (2) The tract was acquired for specific purposes and is no longer required for that purpose or any other federal purpose, (3) Disposal would serve important public objectives, including but not limited to, community expansion or economic development, that could not be achieved prudently or feasibly on land other than public lands and that outweigh other public objectives or values.

The BLM gives priority consideration for identified disposal lands and lands meeting disposal criteria for exchange or public sale identified in the land use plan (Appendix L (p. 1799)). The Buffalo Field Office identifies priority lands in areas adjacent to major blocks of public land, areas with high recreational potential, and areas where easements will improve access.

One 40-acre sale under Revised Statute 2455, which sets forth provisions related to public land sales under the Isolated Tracts Act, occurred in the Buffalo Field Office. There have been 15 FLPMA land sales that occurred since 1985 on approximately 1,304 acres.

Mineral (FLPMA Section 209)

FLPMA specifies that all minerals underlying public lands disposed of by sale shall be reserved to the United States, unless all mineral interest in the lands except where there are no known mineral values or where the reservation of the mineral rights is interfering with or precluding a more beneficial use of the land. FLPMA section 209 also specifies the conditions under which the mineral rights will be conveyed, a mineral report must be prepared to assess fair market value of the minerals, payment of the administrative costs of the sale, payment of fair market value for the mineral rights, and possibly having to perform an exploratory program and preparing a mineral report. The SMCRA defines criteria for minerals in environmentally sensitive areas like steep slopes, timber lands, and prime farmland, including minerals underlying alluvial valley floors. The BLM will provide opportunities for such exchanges while meeting fair market value requirements.

Land Acquisitions (FLPMA Section 205)

The Buffalo Field Office gives priority to lands adjacent to major blocks of BLM-administered public lands. Acquisition is used to acquire key natural resources or acquire legal ownership of lands that enhance the management of existing lands and resources, such as in areas with high recreational or natural resource values. Acquisition of land by purchase is used sparingly given the limited funds available through appropriations. The preferred method for acquisition will be through exchange.

Exchanges (FLPMA Sections 205 and 206)

Exchange is the process of trading lands or interest in lands. BLM-administered public lands may be exchanged for lands or interests in non-federal lands owned by corporations, individuals, or government entities and located in the same state. Exchanges are the primary means by which land acquisition and disposal are carried out. Except for those exchanges that are congressionally mandated or judicially required, exchanges are voluntary and discretionary transactions with willing landowners. Exchanges must be of approximately equal monetary value and located within the same state, be in the publics best interest and conform to applicable BLM land use plans and National BLM policy in BLM Manual 2200–1 Land Exchange Handbook, and meet the requirements of BLM Manual H-2104 Preacquisition Environmental Site Assessment.

Land exchanges are used to improve public lands and interests in land with high public resource management capabilities. Protecting resources and/or implementing management actions on acquired public lands or disposing of public lands that are difficult or expensive to manage, consolidate land and mineral ownership patterns to achieve more efficient management of resources and BLM programs, and dispose of land parcels identified for disposal through the planning process. Recent exchanges resulted in the acquisition of 9,906 acres of private land in the Cow Creek Breaks area and 1,600 acres adjacent to the Tongue River.

Federal law prohibits exchange of public lands in one state for private land in another unless authorized by an Act of Congress. Exchanges are to be of equal value, based on a fair market appraisal, and do not have to be of equal acreage. In other words, exchanges are made on a value-for-value basis rather than an acre-for-acre basis. Furthermore, land exchanges are a discretionary BLM action. BLM is not obligated to process every proposal it receives, even if the proposal has some merit. BLM evaluates exchange proposals in light of existing workloads, funding, and other program priorities when deciding to pursue a land exchange proposal.

Since 1985, the Buffalo Field Office has processed 17 land exchange cases under FLPMA section 206 involving approximately 55,000 acres of non-federal and federal lands. BLM acquired 15,321 acres. There are two exchanges pending. Land exchanges take considerable resource time and generally multiple years to complete. However, little focus on land exchanges in the planning area perpetuates the ongoing fractionated land ownership pattern and limited access to public lands. This creates higher costs for resource planning and administration, and provides little legal authority to obtain access from disinterested land owners.

Recreation and Public Purposes Act Leases and Conveyances

This act of June 14, 1926, as amended in 1988 (43 U.S.C. 869 et seq.), commonly known as the Recreation and Public Purposes Act, authorizes the Secretary of the Interior to lease or convey public lands for recreational and public purposes. The act also authorizes direct conveyance of public lands for solid waste disposal or any other purpose that could result in or include the disposal, placement, or release of any hazardous substance to state and local governments and to qualified non profit organizations. The BLM periodically reviews areas leased or conveyed under the act to ensure continued compliance with the associated terms and conditions. A lease can be terminated or title to patented land can revert to the United States if the authorized entity is not complying with those terms.

To date, the Buffalo Field Office has issued R&PP patents for the Buffalo Housing Authority on one acre, the Buffalo Rifle Range on five acres, the Sheridan Recreation Complex on 560 acres and the City of Buffalo Green Belt consisting of 260 acres. The BLM is considering one conveyance from the town of Kaycee for an R&PP sale for a shooting range.

Trespassing and Illegal Dumping

Trespass actions are uses of public land that occur or are ongoing without specific authorization, or that exceed the established thresholds of an authorization or of casual use. Casual use is defined by the regulations at 43 CFR 2920.0-5(k) as follows:

> “Casual use means any short term noncommercial activity which does not cause appreciable damage or disturbance to the public lands, their resources or improvements, and which is not prohibited by closure of the lands to such activities.”

Trespass actions can cause damage to public lands and natural resources. The cost to resolve trespass and to clean up and reclaim the public land affected by trespass is often passed on to the general public. Trespass resolution involves cessation of the unauthorized use, and could require removal of the unauthorized facilities or appropriate authorization of that use. Three considerations are included in trespass abatement, as follows:

- Payment of the administrative costs to resolve the trespass
- Payment of fair market value for the period of unauthorized use
- Rehabilitation and restoration of the affected public lands

To date, there are approximately 49 identified cases of unauthorized use, occupancy, and development. Several unauthorized uses were informally identified in 2011 and the number is expected to increase substantially in the wake of the intense oil and gas development activities in the area.

Donations and Condemnations

The BLM occasionally receives gifts or donations of lands or interests in land where an entity elects not to receive the market value for the interests being conveyed. Donations are infrequent and cannot be planned for. They are sometimes used in conjunction with other acquisition tools to complete larger transactions. The BLM has not used condemnation in the Buffalo planning area. From the 1960s to 1972, the Buffalo Field Office received nine land donations totaling approximately 80 acres.

Withdrawals and Classifications

A withdrawal is a formal action that sets aside, withholds, or reserves federal lands for public purposes. Table 3.42, “Existing Withdrawals and Classifications in the Planning Area” (p. 417) displays the existing withdrawals and classifications in the planning area. Withdrawals accomplish one or more of the following:

- Transfer total or partial jurisdiction of federal land between federal agencies
- Segregate (close) federal land from operation of some or all of the public land laws and or mineral laws
- Dedicate federal land to a specific purpose

Table 3.42. Existing Withdrawals and Classifications in the Planning Area

Name	Acreage
Resource Protection	
Stock driveways	18,391
Winter Game Ranges	4,583
Classifications	
R&PP Classifications	0
Other Federal Agency Withdrawals	
Bureau of Land Management miscellaneous	968
U.S. Forest Service national recreation sites	3,823
U.S. Forest Service national forests	20,167
U.S. Department of Defense	3,733
Veteran’s Administration	61
U.S. Bureau of Recreation Power Site Classification	6,831

Source: BLM 2010f

Note: Due to overlapping resources, numbers are not additive.

R&PP Recreation and Public Purpose

Withdrawals are established for a wide range of public purposes, including military reservations, administrative sites, national parks and national forests, reclamation projects, recreation sites, stock driveways and power and water site reserves. There are three major types of withdrawals, as follows: (1) Administrative withdrawals – those made by the President, the Secretary of the Interior, or some other authorized officer of the executive branch of the federal government, (2) Congressional withdrawals – withdrawals legislated by Congress, and (3) Federal Power Act (16 U.S.C. 791 et seq.) or Federal Energy Regulatory Commission withdrawals – power project withdrawals established under the authority of the Federal Power Act.

The BLM is responsible for reviewing all proposed administrative withdrawals and restorations; for making recommendations concerning those actions to the Assistant Secretary of the Interior; and for assisting other bureaus and agencies with their withdrawal and revocation programs.

The withdrawal review program is primarily aimed at existing administrative withdrawals and making recommendations concerning the extension, modification, or revocation of the withdrawals. Requirements of national laws and concerns about scarce resources or species in key areas with mineral potential, could justify withdrawal of the land from operation of the mining laws. Land uses can change when withdrawals are revoked. In part this is the result of opening the land to operation under the mining laws. Part of the review process for land withdrawals must include anticipation of any such land use changes.

Management decisions for withdrawals for surface and minerals are considered case by case. Withdrawals are used to segregate or reserve lands for a specific purpose or use. A withdrawal can also transfer jurisdiction of a tract of land under BLM jurisdiction to another federal agency. Withdrawals in the planning area also serve to protect public lands from operation of the public land laws, including the mining laws, but not including mineral leasing laws.

There are several withdrawals in the planning area serving various interests including several stock driveway withdrawals encompassing almost 18,391 acres. There are three crucial winter game ranges for big game in the planning area that the WGFD manage as a wildlife protective area through a cooperative agreement with the BLM. The Amsden Creek (approximately 3,905 acres) and Kerns (approximately 4,949 acres) winter game ranges, located west to northwest of Dayton, Wyoming, managed as a wildlife refuge area withdrawal and the Ed O. Taylor winter game range formerly Middle Fork recreational withdrawal (approximately 10,224 acres) is west of Kaycee, Wyoming. The withdrawal protects the Middle Fork area from mineral entry because this area has unique visual qualities, wildlife habitat, fisheries, and general outdoor recreational qualities.

Because the acquisition program is envisioned to be an ongoing effort, acquisitions through these tools would continue to improve management opportunities, to enhance recreation opportunities, and to further resource preservation. Only very high priority exchanges and acquisitions will be possible. Furthermore, the existing plan contains a maintenance action that establishes criteria for evaluating acquisitions and sales. These criteria are reevaluated and modified in this plan revision.

3.6.2.4. Trends

Currently, there is a substantial need to consolidate land ownership patterns and access routes through sales, exchanges, and acquisitions. The Buffalo Field Office anticipates the land and realty program to be slightly more active during the period of the next plan than during the last 20 years in order to achieve an improved land ownership pattern across the planning area.

Land tenure adjustments (which include sale, acquisitions, and exchanges) in the planning area are rare due to the priority for oil and gas ROW activities over the last several years. However, addressing land tenure adjustments is necessary to improve access and management. Achieving an improved land ownership pattern will reduce management costs, reduce owner conflicts associated with multiple uses on public lands, reduce trespass, and improve a greater overall range of multiple-use opportunities.

Current land disposal consists of two pending land exchanges in the planning area. Current management challenges are primarily related to the focus on oil and gas authorizations and compliance monitoring. Improved public land tenure boundaries and access opportunities across private lands would facilitate a more efficient management framework. An active land tenure program would provide opportunities to consolidate land ownership patterns, and strengthen the Buffalo Field Office ability to access these lands and efficiently manage resources for the protection, conservation, and multiple use of public lands.

Trespass is an ongoing and increasing problem in the Buffalo planning area. Some types of known illegal activities include, but are not limited to, indiscriminate dumping of trash, debris, and household wastes; farming and irrigation of public land; corrals; fences; buildings and construction of roads and other utility-related features.

3.6.2.5. Key Features

The primary key feature is the land tenure pattern (ownership). Key areas in the planning area include:

- The southern region of the planning area, commonly known as the South Big Horns, encompasses resource values including cultural and historical properties, cave and karst sites, wildlife and livestock habitat, and recreation opportunities.
- The eastern region of the planning area is the most likely area for wind-energy development. The Buffalo Field Office manages many small, isolated, and difficult to access parcels in this area. Authorizations for uses on these parcels will likely result from continued oil and gas development and wind-energy development.
- The Powder River and Powder River Breaks, and the northern region of the planning area, encompass a variety of natural formations, include considerable wildlife and livestock habitats, contain considerable oil and gas resources (both federally and privately owned), and offer multiple recreation opportunities.
- Pumpkin Buttes is a natural feature, in the center of the planning area, that can be seen for miles around. This unique, culturally sensitive site is used for communications sites.

3.6.3. Renewable Energy

Information in this section includes a brief summary of the types of renewable energy (wind, solar, biomass, and geothermal), the demand for renewable energy, and federal direction for renewable energy (the National Energy Policy Act of 2005).

3.6.3.1. Regional Context

Renewable energy comes from replenishing sources like wind, sun, water, and heat generated from the earth. Wyoming is considered one of the most viable places in the country for energy development. The planning area is currently experiencing intense oil and gas development activity, primarily CBNG development. These activities are likely to continue into the foreseeable future. There is potential for energy development under new technologies, particularly using renewable energy sources. This will likely affect management actions in the planning area. According to the National Renewable Energy Laboratory (NREL), there is fair to good potential for wind-energy development, and fair potential for solar development. Conversely, there is very little potential for biomass or geothermal development in this area.

The Energy Policy Act of 2005, sections 221 through 237, addresses geothermal development; section 367 addresses ROW fees based on fair market value data. Other potential renewable energy sources not yet identified also would be supported in the planning area considering the use and its relation to other resource objectives and goals.

Section 211 of the Energy Policy Act of 2005 addresses wind-energy activities; implementation of Executive Order 13212 (May 18, 2001) requires the BLM "to expedite projects that will increase the production, transmission, or conservation of energy." Instruction Memorandum 2009-043 is currently being updated and will provide guidance on implementing a record of decision for the programmatic EIS on wind-energy development and guidance on processing ROW applications for wind-energy projects on BLM-administered lands and will be finalized by the time the final resource plan revision is in place.

3.6.3.2. Indicators

Indicators of the success of renewable energy program would be the number of renewable energy ROW authorizations and the acreages involved.

3.6.3.3. Current Condition

Current management and development challenges are unknown because there have been no formal inquiries associated with renewable energy development in the planning area. Given that the area is considered to have moderate potential for wind- and solar-energy development, the Buffalo Field Office is open to these types of uses across the planning area into the foreseeable future. The planning area has not seen any solar renewable energy development, except for some individual solar panels that supplement electricity to individual oil and gas or water wells. This activity is minor compared to the potential within the planning area.

3.6.3.4. Trends

Considering nationwide and statewide trends to pursue clean energy resources, it is reasonable to expect that the Buffalo Field Office will see increased interest in renewable energy development in the future. Recent wind-energy development on private surface in the planning area suggests there will be interest in wind-energy development on public lands in the future. There is moderate potential for wind-energy development in the southern and southeastern regions of the Buffalo planning area.

3.6.3.5. Key Features

The most notable areas identified for wind-energy development are the southern region of the planning area and the southern Big Horn Mountains.

3.6.4. Rights-of-Way and Corridors

A ROW grant is an authorization to use portions of public land for specific facilities, utilities, or transportation for a specified period. The ROW program consists of the evaluation, authorization, and management of ROW for a variety of uses on public land. Most authorizations extend over a 30 year period. ROW are removed and reclaimed upon termination of the grant.

3.6.4.1. Regional Context

Revised Statute 2477 is a contentious issue with those attempting to utilize this statute to cross private lands for recreational purposes. The statute was passed to facilitate early western settlement. Its entire text is stated in one sentence: "the right-of-way for the construction of highways across public lands not otherwise reserved for public uses is hereby granted." The FLPMA repealed Revised Statute 2477 and regulates ROW grants within the BLM.

3.6.4.2. Indicators

The number of ROWs issued, the types of ROWs, and the acreage involved will be the indicators for the success of the ROW program.

3.6.4.3. Current Condition

Most ROWs on BLM-administered lands in the planning area are associated with oil and gas development, electrical transmission, irrigation ditches, and communications. At present, the primary ROWs issued are for site facilities, reservoirs, oil and gas, water, electricity, and roads. The number of communication site ROWs continues to grow. Increasing populations and continued mineral development require utility ROWs to support those infrastructures. Also, changing telecommunications technology is increasing the need for more communication sites and fiber-optic routes. Access roads and utilities associated with development of private lands have become increasingly important. Authorizations must consider all other resource values and their locations.

See Table 3.43, "Existing ROW in the Buffalo Field Office Planning Area" (p. 421) for a list of existing ROW in the planning area.

Table 3.43. Existing ROW in the Buffalo Field Office Planning Area

Existing Authorization	Number of Sites	Acres[1]
Roads[2]	569	15,786
Pipelines/sites (mostly oil and gas related)	441	4,522
Powerlines/sites	435	2,740
Telephone/fiber-optic cables	55	173
Water facility ditches and reservoirs	120	1,077
Communication sites: concentration area south Middle Butte of Pumpkin Buttes	24	17
U.S. Forest Service easements/grants	14	3,289
Other	15	130
Total	1,673	27,734

Source: BLM 2010f

[1] Right-of-way miles were not calculated because there are substantial numbers of existing supplemental uses in the grant information. LR2000 totals do not reflect these supplemental uses and therefore would not be accurate. As a result, the acres were calculated to provide an accurate calculation of actual surface disturbances. Numbers current as of 2011.

[2] Includes railroads and stations, federal highway, and material sites.

ROW Rights-of-Way

The Buffalo Field Office authorizes most ROW disturbances within corridors by placing linear roads, pipelines, and electric lines alongside one another to the extent practical. Generally, the existing identified major corridor routes are localized to major traffic routes. The Buffalo Field Office will continue to coordinate disturbances among operators or development entities to keep disturbance corridors to a minimum. Achieving this will reduce fragmentation of wildlife habitat and surface disturbance.

Since fiscal year 1985, the Buffalo Field Office has processed more than 1,800 ROWs across almost 28,000 acres of public land. The 2001 RMP amendment identified 850 ROWs issued since 1985, a span of 16 years. The remaining 950 grants, were processed after 2001. At present, there are approximately 1,673 authorized ROWs in the planning area.

3.6.4.4. Trends

The Buffalo Field Office historically managed ROWs related to livestock grazing and some oil and gas development. In recent years, CBNG development has dominated ROW activities, and this is likely to continue during the planning period.

The Buffalo Field Office will continue to coordinate disturbances among operators or development entities to keep disturbance corridors to a minimum. Achieving this will reduce fragmentation of wildlife habitat.

BLM policy indicates that using land to capture and sequester carbon will be authorized as a ROW. Interest suggests that the Buffalo Field Office may receive applications to inject carbon dioxide into pore spaces below the surface. Land use authorizations would require rent on the entire subsurface space used, and could encompass thousands of acres.

3.6.4.5. Key Features

Key features are the ROW Exclusion and Avoidance Areas within the planning area which have been specifically identified for the protection of other resources. Individual resource sections in chapters 2 and 4 identify and address the protected areas.

3.6.5. Travel and Transportation Management

Travel management planning is the proactive management of public access in compliance with travel-related regulations and according to the best land use management principles. Travel management planning involves the following (Graves et al. 2006):

- A comprehensive approach that considers various aspects of road and trail system planning and management; natural resource management; road and trail design and maintenance; and recreation and non-recreation uses of roads and trails
- Route inventory and evaluation, innovative partnerships, user education, mapping, monitoring, signage, field presence, and law enforcement
- All resource aspects (recreational, traditional, casual, agricultural, industrial, educational, and cultural) and accompanying modes and conditions of travel on the public lands, including motorized, mechanized, and nonmotorized/mechanized uses

3.6.5.1. Regional Context

Travel and transportation decisions include allowable types of travel (over land, water, and snow, and by air), and modes and conditions of travel on public lands. Pivotal to the BLM strategy for managing public lands is maintaining and improving on the BLM transportation system which includes roads, bridges, trails, and related facilities in a manner that enhances accessibility, connectivity, and safety, while addressing public needs, preserving ecological functions, and fostering economic development (BLM 2001b). Map 52 illustrates the preliminary transportation network for the Buffalo Field Office.

A well-functioning transportation system is essential for resource extraction, energy production, and recreational activities on BLM-administered lands. In addition to allowing the BLM to achieve its agency goals – sustaining the health, diversity, and economic vitality of our public lands – transportation enables ongoing contributions to the regional and national economies.

In BLM-administered areas where there are unique circumstances, high levels of controversy, or complex resource considerations, a Travel Management Area (TMA) may be delineated to address particular concerns and prescribe specific management actions for a defined geographic area. TMAs are areas where a rational approach has been taken to classify the area as Open, Closed, or Limited. An individual Special Recreation Management Area (SRMA) is often also a TMA.

3.6.5.2. Indicators

The indicator for the program is the increase or decrease in transportation routes or access opportunities to and on BLM-administered lands. TMAs are usually identified where travel and transportation management (either motorized or nonmotorized) requires particular focus or increased intensity of management. While OHV-area designations are land use plan allocations, TMAs are planning-tool delineations (BLM 2007j). TMAs may be established during the planning process or during the development of a Recreation Area Management Plan. All designated travel routes in TMAs should have a clearly identified and documented need and purpose, and clearly defined activity types, modes of travel, and seasons or timeframes for allowable access or other limitations.

3.6.5.3. Current Condition

County roads providing critical access to larger parcels of BLM-administered lands include Hazelton Road, Barnum Road, Mayoworth/Slip Road, Trabing Road, Tipperary Road, Sussex Road, Upper and Lower Powder River Road, Irigary Road, Schoonover Road, Napier Road, Bishop Road, and Elk Creek Road. Most county roads are also designated as stock driveways. The transportation infrastructure, traffic volume, and accident rates in the planning area are relatively low due to small populations in the counties.

At present, the Buffalo Field Office maintains 16.5 miles of roadways in the planning area. However, the much larger network of unimproved, two-track and industrial roads are not included in this figure. According to the 2003 Powder River Basin Final EIS, approximately 7,135 miles of new improved and 10,619 miles of two-track roads are being developed in conjunction with CBNG facilities, both on public and private lands. Some of these roads have not been constructed or maintained to BLM standards. In an effort to minimize road footprints and accommodate use, the BLM has previously issued decisions to allow roads that do not meet BLM standards. Over time, these roads have become a safety and resource concern. The potential for maintaining these roads to provide public access to public lands is uncertain at this time.

Travel Management and Off-Highway Vehicles

OHV use continues to increase in popularity and includes four-wheel-drive, sport utility, and all-terrain vehicles (ATVs). Typical recreational OHV activities in the planning area include exploring, ATV and motorcycle trail riding, and OHV use related to hunting. In addition, OHV use can provide access over long distances for hunters and subsequent nonmotorized recreational purposes such as fishing, hiking, mountain biking, horseback riding, and primitive camping opportunities. People with disabilities may be allowed to travel on OHVs in otherwise closed areas on a case-by-case basis with a permit from the WGFD and authorization from the BLM authorized officer. Table 3.44, “2010 Motorized and Nonmotorized Activities and Number of Participants in the Buffalo Planning Area, Wyoming” (p. 424) lists the numbers of participants in motorized and nonmotorized recreational activities.

Table 3.44. 2010 Motorized and Nonmotorized Activities and Number of Participants in the Buffalo Planning Area, Wyoming

Motorized Activities	Number of Participants
Driving for pleasure	2,682
Hunting – Big Game (assumes use of four-wheel-drive vehicles and ATVs)	10,150
OHV – ATV	3,105
OHV – cars, trucks, and sport utility vehicles	1,778
Nonmotorized Activities Requiring Vehicle Access	**Number of Participants**
Bicycling (Mountain & Road)	666
Fishing	3,104
Hiking, walking, and running	5,646
Horseback riding	1,048
Hunting – Small game, Upland Bird, Waterfowl, Other	1,765
Picnicking	2,984
Camping	2,720
Source: BLM 2011h ATV All terrain vehicle OHV Off-highway vehicle	

The road network in the planning area is comprised of a series of county roads, BLM-maintained roads, existing two-track roads, and snowmobile trails. The maintenance and use of these travel routes has become an integral part of public land management because these roads are used for both recreational and non-recreational purposes. Motorized off-road travel to perform necessary tasks and casual use, which includes activities such as retrieving big game kills, livestock management, and energy-related exploration, is currently allowed. Non-recreational OHV use in the planning area is predominately related to rangeland management and energy development and is usually managed under an authorization or permit. The BLM uses OHVs under administrative use for inspections, vegetative treatments, surveying, mapping, inventories, monitoring, fire suppression, and project construction and maintenance.

Travel Management Designations

The BLM must designate all public lands as Open, Closed, or Limited for OHV use. Area and trail designations are completed during the planning process and are limited to the following three management categories:

- *Open:* Areas used for intensive OHV use where there are no compelling resource needs, user conflicts, or public safety issues to warrant limiting cross-country travel. Areas where all types of vehicle use are permitted at all times anywhere in the area.
- *Limited:* Areas or trails where the BLM restricts OHV use to meet specific resource management objectives. These limitations can include limiting the time or numbers and

types of vehicles; limiting the time or season of use; permitted, licensed use only; limiting to existing roads and trails; and limiting use to designated roads and trails. The BLM may place other limitations, as necessary, to protect other resources, particularly in areas that motorized OHV enthusiasts use intensively or where they participate in competitive events.

- *Closed:* Areas where the BLM enforces a closure to all vehicular use when it is necessary to protect resources, ensure visitor safety, or reduce conflicts, including units in the National Wilderness Preservation System. Access by means other than motor vehicles (i.e., foot, horseback, and bicycle) is generally allowed.

Table 3.45, "OHV-Use Designations in the Planning Area" (p. 425) identifies the acreages of OHV-use designations in the planning area as identified in the existing plan.

Table 3.45. OHV-Use Designations in the Planning Area

Designation	Acreage
Open areas: Vehicle travel is permitted both on and off roads if the vehicle is operated responsibly in a manner unlikely to cause substantial undue damage to the environment.	20,386
Closed areas: Travel by vehicles, including snowmobiles, is prohibited.	3,704
Limited areas A: Use is limited to existing roads and vehicle routes in existence as of 1985.	566,184
Limited areas B: Use is limited to designated roads and vehicle routes in these areas. (Until signs are posted, vehicle travel is limited to existing roads and vehicle routes.)	170,982
Limited areas C: Vehicle travel is closed to all motor vehicles, including snowmobiles, from December 1 to April 15.	37,646
Total	**798,848**
Sources: BLM 2001a; BLM 2012f OHV Off-highway Vehicle	

OHV Use and Environmental Concern

It is reasonable to expect impacts from OHV use to accumulate over time as visitation increases and new roads and trails develop. Dispersal of OHV use is directly related to the size and percentage of federal parcels in a given area and the ease of public access. Unregulated use can heavily impact popular areas (e.g., Weston Hills and Middle Fork Powder River area) with high concentrations of OHV use. Adverse impacts include habitat fragmentation, increased soil erosion, stream sedimentation, physical damage to vegetation, and damage to vegetative communities due to the spread of invasive plant species. Environments that are more susceptible to OHV-related damage include crucial winter ranges, wildlife breeding areas, riparian habitats, and areas with steep slopes, wetlands and riparian areas or sensitive soils.

Current OHV management allows off-road and trail travel for motorized use to perform necessary tasks and for casual use, which includes activities such as retrieving big game kills, livestock management, and energy-related exploration. Impacts related to necessary tasks and casual use are increased soil erosion, habitat fragmentation, route proliferation, visual degradation, and degradation of recreational settings.

The BLM objective is to improve a selective public lands transportation system that will contribute to a safe and adequate network of roads and trails to improve public access while protecting sensitive resources and reducing environmental impacts. Meeting current OHV management challenges will require the BLM to continue to gather data for needs analyses, coordinate with adjacent agencies and partners to improve consistency in transportation planning procedures and the designation and data needs, and to continue to provide updated and current transportation information and an improved road and trail system.

3.6.5.4. Trends

Prominent among the travel management issues the BLM faces is the complex challenge of managing motorized activities on public lands. The combined effect of population increases in the west, growth in the use of OHVs in the planning area over the last 10 years, and technological advances has generated increased social conflicts and resource impacts on public lands related to motorized recreation, and impacts to other recreation activities and resource uses.

Indiscriminate use of OHVs continues to increase, creating unauthorized pioneered trails. These trails can scar landscapes, dissect vital wildlife habitats, increase the degradation of cultural and paleontological resources, and cause increased erosion to fragile soils. The environmental impacts of OHV use are becoming apparent in the planning area, most notably in the Weston Hills Recreation Area and on BLM-administered lands in the southern Big Horn Mountains. The Powder River Breaks south of Interstate 90 also experience heavy vehicle traffic because the area is designated as Open for OHV use. OHV users often adopt routes created by necessary tasks and casual use and perceive them as existing routes. This trend creates an increase in roads and trails. In areas where vehicle use is limited to existing roads and trails, issues arise on user created routes because subsequent users can legally operate on non-designated routes.

3.6.5.5. Key Features

Open Areas

Both the 1985 RMP and 2001 Update designated 20,386 acres as Open, where vehicle travel is allowed both on and off roads if the vehicle is operated responsibly in a manner unlikely to cause substantial undue damage to the environment. These areas include all stock driveways and rests, and approximately 3,460 acres south of Interstate 90 at its junction with the Powder River.

Limited Areas

Approximately 97% (774,184 acres) of the planning area is designated as “limited to existing” or “limited to designated” roads and trails (Map 53). Although there are approximately 800,000 acres of BLM-administered land in the planning area, public access via motorized routes is only available to approximately 400,000 acres. The limited use designations were originally intended to allow OHV use without increasing the number of acres disturbed. Additionally, the designation of routes will assist in reducing physical impacts and conflicts between various uses. Recreational users within “limited” areas cannot travel off roads and trails except during the performance of “necessary tasks,” such as for game retrieval. Since the 1985 RMP and the 2001 Amendment, OHV use in the planning area has increased dramatically. OHV users are creating new trails every year, especially during the hunting season.

Closed Areas

Areas closed to all OHV use include 40 acres in the Dry Creek Petrified Tree EEA, 572 acres in Cantonment Reno, and 3,038 acres in Middle Fork Canyon. These areas have special resource concerns and were closed to OHVs as a protective measure. This management action has proven an effective way to protect cultural and natural resources from unnecessary degradation.

3.6.6. Recreation

As one of the DOI four primary missions, recreation is an important BLM program. The primary mission of the outdoor recreation program is to provide a broad spectrum of resource-dependent recreational opportunities to meet the needs and demands of visitors to public lands. The Recreation and Visitor Services (R&VS) program also seeks to maintain high-quality recreation facilities that meet public needs and enhance the image of the agency, as well as to improve understanding of public land resources and foster support of the BLM by effectively communicating the agency's multiple-use management programs to the recreation visitor. *BLM's Priorities for Recreation and Visitor Services* (BLM 2007b) identifies seven objectives for the R&VS program. These include:

- Manage public lands for recreation experience and quality of life outcomes.
- Encourage sustainable travel and tourism development with gateway communities and provide community-based conservation support for visitor services.
- Provide fair value and return for recreation through fees and commercial services.
- Establish a comprehensive approach to travel management and planning.
- Ensure public health and safety, and improve the condition and accessibility of recreation sites and facilities.
- Enhance and expand visitor services, including interpretation, information and education.
- Encourage and sustain collaborative partnerships, volunteers and citizen-centered public service.

3.6.6.1. Regional Context

Recreation planning produces opportunities for visitors to experience desired physical and social outcomes. Recreational values are considered in management through the understanding that settings provide opportunities for experiences created by visitors and that a diversity of settings provides the basis for quality recreation experiences. The responsibility for managing for various types of settings lies with the land management agency. Settings are comprised of a variety of attributes such as biophysical (human-induced and natural environment), social (visitor type and density), and managerial (regulations and facilities). Each of these attributes differs, thus facilitating some experiences and hindering others. By providing a diversity of settings with varying attributes over space, and making visitors aware of those opportunities, public land managers ensure that visitors are capable of producing quality experiences (McCool et al. 2007). Decisions for the recreation program should be responsive to past changes and adaptive to future changes in technology, sources of information, demographics, and population dynamics.

Visitors come to the planning area from all over the United States and from international locations. The location of the planning area in relation to other natural areas (Yellowstone National Park and the Bighorn National Forest to the west, Montana to the north, the Black Hills to the east, and the Front Range to the south), the accessibility of the planning area via major interstate corridors and the abundant natural and cultural resources of northeastern Wyoming drive visitation. Historically, the summer months of June through August receive the heaviest use related to non-consumptive recreation. Hunting season (September through November) also brings high visitation to the planning area, with the highest use occurring on large tracts of BLM-administered lands with public access. However, research predicts that as the retirement population in the United States increases, many public lands will experience more consistent year-round use as retired visitors exercise the ability to travel and recreate year-round (McCool et al. 2007).

Recreation on public lands provides regional economic benefits. Recreation service providers (e.g., hotels, outfitters, equipment manufacturers and dealers, and restaurants) depend in part on public lands for their livelihoods. One study (Sonoran Institute 2006) showed that annual expenditures from hunting and fishing in Wyoming exceeded $335 million and that hunters spent 74% of their hunting days (960,000 days) on public lands. A 2009 Wyoming Travel Impact Report estimates that travel and tourism to Wyoming generated more than $3.1 billion in direct spending and resulted in $128 million in state and local tax revenues and supported approximately 30,500 jobs (with earnings of $761 million) for Wyoming residents (Dean Runyan Associates 2013).

Recreational opportunities are offered to the public on BLM-administered lands in the planning area where there is legal access. The BLM provides opportunities for outdoor recreation and nature-based tourism using the concept of multiple-use management. Research and regional scoping meetings have identified that the public values natural landscapes, the freedom to choose a particular activity in which to participate, the opportunity to test skills, time spent with family and friends, and the opportunity for discovery. In addition, Johnson and Sheridan counties were identified as non-metropolitan counties with "significant concentrations of recreational activity" and recreation-driven economic growth (Johnson and Beale 2002).

3.6.6.2. Indicators

The indicator for the recreation program is the ability to provide a spectrum of recreation opportunities (i.e., primitive, developed, extractive and non-extractive) on BLM-administered lands. Visitor satisfaction can often identify when and where additional opportunities are necessary.

3.6.6.3. Current Condition

The approximately 800,000 acres of BLM surface in the planning area receive an estimated 30,000 recreation visits per year (BLM 2013e). The towns of Sheridan, Buffalo, Gillette, Arvada and Kaycee are adjacent to public lands used by local residents as community recreation areas. Visitation to Mosier Gulch, Welch Ranch, Dry Creek Petrified Tree, Weston Hills and Burnt Hollow predominately consists of local residents. Middle Fork and Hole-in-the-Wall draw visitation from a much broader region; it is not uncommon to find visitors from Colorado, Nebraska and Montana at Outlaw Cave. Both the southern Bighorns and the Powder River Basin attract many out-of-state hunters to BLM recreation sites and tracts with public access. Hunting associated with commercial guides also occurs on public lands without public access.

The Buffalo Field Office recreation program is responsible for maintaining developed recreation sites ranging from minor access route improvements to trailheads, primitive campgrounds, and day-use areas. The BLM posts public and private land boundaries, interprets resources, and provides regulatory and informational kiosks in high-use areas. Detailed information is available to the public via informational pamphlets, land ownership maps, and online websites. BLM personnel encourage the principles of programs such as Leave No Trace and TREAD Lightly! through public outreach. Law enforcement is also an integral part of the recreation program.

Several developed recreation sites in the planning area are closed to livestock grazing (Mosier Gulch, Dry Creek Petrified Tree EEA). Additionally, the discharge of firearms, projectiles, other weapons, and fireworks within developed recreation sites is prohibited per 43 CFR 8365.2-5(a). Prohibiting the discharge of projectiles and weapons at developed recreation sites not only prevents damage to facilities (signs, picnic tables, etc.), it reduces the possibility of accidental injury to other visiting recreationists.

Monitoring and enforcement of dispersed recreation is severely limited, especially in areas with a small percentage of public lands and limited access. The BLM depends on cooperation from public land users and other federal and state agencies for successful management of these areas. Cooperation from public land users is received through voluntary compliance with regulations and contributions of noncompliance information. The WGFD and local law enforcement agencies help provide an official presence that would otherwise not be available. Management prescriptions emphasize monitoring, education, and enforcement to reduce user conflicts and provide resource protection.

Most of the complaints the BLM has received involve illegal posting or otherwise restricting public access to federal lands, trespass onto private lands, vandalism to vegetation and soils, illegal dumping and failure to maintain roads. In addition, the BLM has received complaints about unpermitted outfitters and guides, and the careless discharge of weapons near infrastructure associated with various developments. All complaints are investigated or handled case by case.

Special Recreation Permits

The Buffalo Field Office issues an assortment of special recreation permits (SRPs) for a range of activities, including commercial use, competitive use, vending, and organized group activities or events. SRPs are required for commercial or organized recreational uses of public lands and related waters. SRPs manage visitor use, protect natural and cultural resources, and provide a mechanism to accommodate commercial recreational use. The BFO currently manages 46 SRPs, most for commercial outfitting and guide services. Fees collected from SRPs average between $10,000 and $12,000 per year and are used to improve facilities or support programs within the planning area.

Undeveloped/Dispersed Recreation

Dispersed recreation occurs throughout the planning area over a wide range of ecosystem types. Occurring in combination with other resource activities, dispersed recreation includes but is not limited to hunting, camping; hiking, sightseeing; OHV use; vehicle touring; backpacking; horseback riding; photography; wildlife viewing; geo-caching; and fishing, boating, and other water-related activities.

Hunting, camping, fishing, and vehicle touring are among the most common recreational activities on BLM-administered public lands in the Buffalo planning area. All BLM-administered lands allow for hunting and many areas are open to target shooting unless posted otherwise. Restrictions on gun use include a prohibition on shooting within developed recreation sites and areas and upon, along or across roadways. Vehicle touring is generally in conjunction with hunting, fishing, rock hounding, equestrian use, camping, or hiking. During hunting season, there is an increase in use of motorized vehicles throughout the planning area.

By definition, dispersed recreation is comprised of small events distributed over large areas. Impacts such as minor disturbances to soil and vegetation are negligible and the environment tend to recovery quickly. However, long-term cumulative impacts could occur in association with dispersed recreational activities. They are normally, but not exclusively, linked to heavily used areas and could include soil compaction and erosion, dispersal of invasive plant species, the creation of unauthorized two-track roads and trails, and the purposeful vandalism of natural and cultural resources. Over time, recreational activities could adversely impact sensitive soils, wildlife habitat, riparian areas and important cultural and historical sites.

Recreation Management Areas

A recreation management area (RMA) is a land unit where R&VS objectives are recognized as a primary resource management consideration and specific management is required to protect the recreation opportunities. The RMA designation is based on: recreation demand and issues, recreation setting characteristics, resolving use/user conflicts, compatibility with other resource uses, and resource protection needs. A RMA is designated as either a special recreation management area (SRMA) or an extensive recreation management area (ERMA). SRMAs recognize unique and distinctive recreation values and are managed to enhance a targeted set of activities, experiences, benefits, and recreation setting characteristics, which becomes the priority management focus. ERMAs recognize existing recreation use, demand, or R&VS program investments and are managed to sustain principal recreation activities and associated qualities and conditions of the ERMA, commensurate management with other resources and resource uses.

Both SRMAs and ERMAs must have measurable objectives. SRMAs are recognized as the predominant LUP focus for R&VS, where specific recreation opportunities and recreation setting characteristics are managed and protected on a long-term basis. Therefore, in SRMAs the identification of recreation as the “predominant use” could constrain other uses and resources. ERMAs, in contrast, are managed commensurate with the management of other resources and resource uses. Thus, the essential difference between SRMAs and ERMAs is not necessarily the level of visitor use or necessary investment on the part of the BLM, but whether the area is to be managed with recreation as the predominant use (SRMA) or recreation is to be managed as a commensurate use with other resources or resource uses (ERMA).

Special Recreation Management Areas

SRMAs are an administrative unit where the existing or proposed recreation opportunities and recreation setting characteristics are recognized for their unique value, importance and/or distinctiveness, especially as compared to other areas used for recreation.” These areas are identified during the resource management planning process and are traditionally areas that experience higher recreation use, require extra recreation investment, or need more intensive recreation management. SRMAs must have a distinct, primary recreation-tourism market (destination, community, or undeveloped) and a corresponding and distinguishing recreation management strategy. The 1985 Buffalo RMP and the 2001 RMP Update did not designate any SRMAs. However, the 1985 RMP did designate the following two parcels as recreation areas:

- Weston Hills Recreation Area – Parts of this area are managed as undeveloped and developed recreation areas. Weston Hills is open to motorized vehicle use, and common activities include mountain bicycling, camping, hiking, horseback riding, big game hunting, and OHV use (ATVs and four-wheel-drive vehicles).

- Mosier Gulch Recreation Area – This area is managed as a developed recreation area. Mosier Gulch is open to motorized vehicle use, and common activities include fishing, hiking, mountain biking, picnicking, and wildlife viewing.

The 2001 RMP Update also prioritized recreation and prescribed management objectives in the Middle Fork, Dry Creek Petrified Tree, Weston Hills, and Mosier Gulch management areas and for the Gardner Mountain Trail. Management of recreation values or interpretive materials was also specifically addressed for Fortification Creek, Cantonment Reno and Crazy Woman Battle Site.

Two recreation sites, Burnt Hollow and Welch Ranch, were acquired after the RMP was last update or amended. Recreation management was prioritized for both of these sites in site-specific management plans.

Based on visitor use, recreation setting, and desired future conditions identified in land use plans, there are seven areas in the planning area equivalent to SRMAs (Table 3.46, "Special Recreation Management Area Equivalents in the Planning Area" (p. 431)).

Table 3.46. Special Recreation Management Area Equivalents in the Planning Area

Recreation Management Area	Market and Type of Recreation
Burnt Hollow	Undeveloped; nonmotorized
Dry Creek Petrified Tree	Destination; nonmotorized
Middle Fork Powder River	Destination; motorized and nonmotorized
Mosier Gulch	Community; nonmotorized
Welch Ranch	Community; nonmotorized
Weston Hills	Community; motorized and nonmotorized

Extensive Recreation Management Areas

ERMAs are an administrative unit that requires specific management consideration in order to address recreation use, demand, or R&VS program investments. ERMAs are managed to support and sustain the principal recreation activities and the associated qualities and conditions of the ERMA. Management in all ERMAs is focused on custodial implementation actions that address visitor health and safety, user conflicts, resource protection issues, and maintaining access or appropriate activity participation. The BLM often designates multiple ERMAs in a planning area based on homogenous land type or recreational opportunity factors across a large area. Lands with public access are available for dispersed recreational use by the general public. Actions proposed under other resource management programs will generally affect the recreation resource more significantly in areas with legal public access.

Public Lands Not Designated as Recreation Management Areas

Public lands that are not designated as SRMAs or ERMAs are managed to meet basic R&VS and resource stewardship needs. Recreation is not emphasized, however recreation activities may occur (except on any lands closed to public use). Currently, there are no lands identified as closed to public entry or use in the planning area. The R&VS for lands outside of RMAs are managed to allow recreation uses that are not in conflict with the primary uses of these lands. In general, these lands in the planning area will include BLM-administered parcels without legal public access. Recreation can and often does occur on lands without public access; these parcels are primarily used for recreation by adjacent private landowners or commercial outfitters and guides operating under a SRP.

3.6.6.4. Trends

Management practices change over time as social priorities shift and new scientific knowledge enhances the ability to responsibly manage differing land uses. Over the past 20 years, there has been a major shift in the way land management agencies view outdoor recreation. Public lands have always provided recreation opportunities. However, outdoor recreation is now recognized as an important land use providing social and economic benefits on national, regional, and local levels.

Recreation demands are expected to increase in conjunction with population. Several of the fastest-growing (percent-change) activities through 2050 measured in activity days are expected to include visiting historic places, snowmobiling, sightseeing, and non-consumptive wildlife activities (Bowker et al. 1999). Increased public demand for the services provided by commercial, competitive, and organized activities on public lands is also anticipated.

3.6.6.5. Key Features

The following paragraphs describe several features of particular importance to recreation on BLM-administered lands in the planning area. The BLM will use these key areas to shape management allocations and recreation management decisions during the planning process.

BLM-Administered Lands Adjacent to Walk-In Hunting or Fishing Areas

Wyoming Game and Fish Department manages the Private Lands Public Wildlife Access program to improve public access for hunting and fishing opportunities. Walk-in agreements are negotiated between WGFD and private landowners for a specific period of time, usually several years, and thus the status of an access areas can change during the life of this plan. BLM-administered lands adjacent to Walk-In Areas provide additional access and hunting and fishing opportunities for recreationists. While the WGFD and the adjacent private landowner have authority over any lands enrolled in the program, the BLM can support the objectives of the Private Lands Public Wildlife Access program through collaborative management.

Burnt Hollow

Burnt Hollow Management Area (BHMA) consists of approximately 18,000 acres of public land accessible via State Highway 59 North approximately 20 miles northeast of Gillette, Wyoming. The management area includes Cow Creek Breaks. Highway 59 borders approximately 2.4 miles of the area, providing public access. There are two developed parking areas along this route. There is an undeveloped parking area on state land at the northeast end of the area. This parking area is accessed via Cow Creek Road, which runs for 1.9 miles along the Burnt Hollow boundary.

The area offers varied topography, including rolling sagebrush-grasslands, steep precipitous drainages, scoria buttes, and clayey outcrops with juniper and ponderosa pine uplands. Several intermittent drainages contain plains cottonwood and junipers. Springs and small wetlands are scattered throughout the BHMA. Livestock grazing, wildlife habitat, and limited mineral development are the historic land uses.

The few existing two-track roads in the BHMA were created for mineral exploration and livestock management and are only open for motorized use under administrative and permitted actions.

The BHMA features opportunities for nonmotorized dispersed recreation, including camping, mountain bicycling, environmental education, hiking, horseback riding, small- and big-game hunting, picnicking, and wildlife viewing. Overnight camping, campfires are prohibited in the developed parking areas. The management area is closed to target shooting.

Cabin Canyon

The Cabin Canyon area is located off of Bishop Road approximately 22 miles southeast of Gillette, and is a 1,369 acre parcel with public lands surrounded by approximately 2,460 acres of adjacent state lands. The area has experienced increased motorized use, both on and off designated routes. Current uses are predominately mineral extraction and grazing, but motorized recreational use is slowly increasing. Recent complaints from the public regarding the proliferation of user created routes, litter, recreational shooting, established campsites, and other activities have increased education and enforcement efforts in this area.

Dry Creek Petrified Tree Environmental Education Area

The Dry Creek Petrified Tree management area is a 2,567 acre environmental education site primarily used by tourists and students. The area highlights 60 million year old remnants of petrified Metasequoia trees within red sage hills and sagebrush country. The area is approximately 8 miles east of Buffalo, Wyoming, and access is via Johnson County's Tipperary Road. The area includes a developed parking area with an outdoor toilet accessible to people with physical disabilities. The Dry Creek Petrified Tree EEA has an 0.75 mile interpretive trail; signs identifying the area and its unique values are posted on the site. The area is open to nonmotorized recreation opportunities, including cycling, hiking, and small- and big-game hunting. Open fires and discharge of firearms are not allowed in the developed parking area or the interpretive site. Vehicle access into the area is allowed for administrative purposes and livestock operations along existing primitive resource roads; these roads are open to nonmotorized use by the public. Vehicle use beyond the parking area is prohibited.

Hole-in-the-Wall

The Hole-In-The-Wall is part of a colorful and scenic red sandstone escarpment know as the Red Wall. The area is a historic site on BLM-administered land approximately 16 miles southwest of Kaycee, Wyoming. The area is accessible via trailheads along Natrona County 105/Buffalo Creek Road; however, vehicle access to Hole-In-The-Wall proper is limited due to land ownership patterns. The location is best known for legends of outlaw activity in the late 1800s, most notably involving Butch Cassidy and the Wild Bunch Gang. The area includes a public viewing and parking area and trailhead, with interpretive signs. More than 2.5 miles of trails are open to nonmotorized use. The surrounding area is open to motorized dispersed recreation where designated, including driving for pleasure along Johnson County roads.

Kaycee Stockrest

The BLM administers approximately 2,685 acres just northwest of the City of Kaycee. Public access is available via Highway 191 or a public easement issued to Johnson County. Approximately 200 acres is a designated stockrest. This unit has historically been used for recreational target shooting and OHV riding by local residents. The BLM received a proposal for consideration of the development of a shooting range at the site in 2009. An additional 2,485 acre parcel provides some hunting opportunities during the fall.

Middle Fork Recreation Area and Outlaw Cave

The Middle Fork Recreation Area is a spectacularly scenic part of the Old West encompassing approximately 10,083 acres. The Middle Fork area is topographically diverse, ranging in elevation from 5,000 to 8,000 feet, with numerous steep incised canyons, a red sandstone escarpment known as the Red Wall, and open grassland parks interspersed with ponderosa pine, Douglas fir, and limber pine forests. The wildlife found here are just as varied – elk, mule deer, pronghorn, mountain lions, eagles, and other small mammals and rodents. The Middle Fork Powder River is a blue ribbon trout stream containing brown and rainbow trout. The area includes the Ed O. Taylor Wildlife Habitat Area managed by the WGFD.

The Middle Fork area is approximately 20 miles southwest of Kaycee, Wyoming, and is accessible via State Highway 190 and Barnum Road. Multiple named roads provide approximately 50 miles of access routes to the area, including Barnum Mountain Road, Outlaw Cave Road, South Slope Road, Bachus Pasture Road, Buffalo Creek Road, Hazelton Road, and Bar C Road. There are another 18 miles of primitive access roads in the SRMA; however, vehicle and OHV use is allowed only on designated trails. The area is open to motorized and nonmotorized recreation opportunities such as camping, freshwater fishing, cycling, hiking, big-game hunting, and OHV (ATV and four-wheel-drive vehicles) use on designated routes.

Outlaw Cave is in the Middle Fork Recreation Area and has 0.5 mile of access road to a developed campground. There is approximately 1 mile of hiking trails to access the Middle Fork Powder River via the Middle Fork Canyon trail. An outhouse is provided; however there is no potable water at the campground. The site includes picnic tables and fire rings. A fire swept through the area in 2006, taking many of the mature trees. The area also contains archeological sites dating back to the prehistoric period, including stone circles, quarry sites, rock art, and curious petroglyphs.

Mosier Gulch

The Mosier Gulch Recreation Area is an approximately 1,026-acre parcel accessed via State Highway 16 West approximately 3 miles west of Buffalo, Wyoming. Approximately 0.5 mile of improved resource road provides access into the area’s two developed parking areas. An outdoor toilet is available and is accessible to people with physical disabilities. A hand-pumping water well and four picnic sites with tables and grills provide opportunities for picnicking. There are two undeveloped parking areas. An interpretive sign that identifies the area and its facilities is posted on the site. Overnight camping, open fires, and the discharge of fire arms are prohibited in the parking or picnic areas. The area is closed to motorized use beyond the improved access road. The area is open to nonmotorized recreation opportunities including picnicking, freshwater fishing, hiking, and small- and big-game hunting.

North Bighorns Parcels

The BLM manages approximately 2,926 acres 13 parcels ranging from 40 acres to 650 acres adjacent to the Bighorn National Forest in Sheridan County, and one 40 acre parcel along Keystone Road. Public access to these parcels includes Highway 14, Smith Creek Road, Red

Grade Road, Keystone Road, Little Goose Creek Road, and walk-in access from the national forest. Recreational use, including staging and riding of OHVs on parcels adjacent to public roads is known to occur.

Trails

In addition to designated OHV trails (see *Travel and Transportation Management* section above), there are several trails for nonmotorized use in the planning area. Developed hiking trails in the planning area include Gardner Mountain Foot and Horse Trail, Hole-in-the-Wall Trail, Outlaw Cave Fishing Access Trails, the interpretive trail at the Dry Creek Petrified Tree EEA, and Poison Creek Trail.

Welch Ranch

The Welch Ranch Management Area is a 1,748-acre parcel approximately 10 miles north of Sheridan, Wyoming. Welch Ranch is in the Powder River Basin, a part of the Northern Great Plains, which includes most of northeastern Wyoming and a portion of southeastern Montana. The Big Horn Mountains are within sight of Welch Ranch to the west. The Welch Ranch area is accessible from Sheridan via Wyoming State Highway 338 (Decker Road). There are two developed parking areas at the junction of Highway 338 and the Tongue River, with directional signs identifying the area. The few existing two-track roads in the Welch Ranch were originally created for mineral development and livestock management and are currently only open for motorized use under administrative and permitted actions.

Welch Ranch occupies a portion of the Tongue River valley floor and the adjacent dissected uplands between Ash Creek and Hidden Water Creek. Approximately 1.5 miles of the Tongue River run through the eastern portion of the Welch Ranch area. There is a coal seam fire on a ridge in the southwestern corner of Welch Ranch. Evidence of historic wildland fire is apparent from several fire events in the past few decades.

The area offers nonmotorized dispersed recreation, including camping, mountain bicycling, fishing, hiking, horseback riding, small- and big-game hunting, upland bird hunting, picnicking, wildlife viewing, bird watching, and float trips. Motorized use and target shooting are prohibited in the management area. Overnight camping, open fires, and discharge of firearms are prohibited in the developed parking area.

Weston Hills

The Weston Hills area consists of approximately 9,500 acres of BLM surface lands adjoining the Thunder Basin National Grassland. The USFS jointly manages Weston Hills. The area is 25 miles northeast of Gillette, Wyoming, and accessible via State Highway 59 North.

Elevations in the Weston Hills Recreation Area range from 3,800 feet to more than 4,500 feet. The lower elevations are grasslands with some juniper, while the upper elevations are ponderosa pine-covered hills and steep drainages interspersed with meadows and scoria outcrops. From vantage points in Weston Hills Recreation Area, one can see the Big Horn Mountains to the west and Devil's Tower to the east.

There are 5.9 miles of improved resource roads into the SRMA with two parking areas, both on USFS surface. One parking area is unimproved; the other is improved with an outdoor toilet accessible by people with physical disabilities. There also is a warm-water fishing pond at the site. The area is open to motorized and nonmotorized recreation opportunities, including mountain bicycling, hiking, horseback riding, small- and big-game hunting, fishing, and OHV use. Target shooting is prohibited on the Thunder Basin National Grassland and a temporary shooting closure was implemented on BLM-administered lands at Weston Hills in 2008. There are approximately 10 miles of primitive roads and OHV trails with use restricted to marked routes only. There are another 6.4 miles of trails open to nonmotorized use.

3.6.7. Lands with Wilderness Characteristics

Wilderness characteristics include, but are not limited to, naturalness, solitude, outstanding opportunities for primitive and unconfined recreation, special features, diversity, and other features of the land associated with the concept of wilderness. Citizen's Wilderness Proposals, new acquisitions, and contiguous areas of BLM surface with at least 5,000 roadless acres are considered for wilderness characteristics.

Under FLPMA section 201, the BLM considers new information related to wilderness characteristics when preparing land use plans. Lands with wilderness characteristics may be managed to protect and preserve some or all of those characteristics through a land use planning process. Lands with wilderness characteristics are parcels that meet a size requirement of 5,000 acres (or exception criteria) and contain naturalness and either outstanding opportunities for solitude or primitive and unconfined recreation. In addition, they may also possess supplemental values (e.g., ecological, geological, or other features of scientific, educational, scenic, or historical value). They are identified through a process described in BLM Manual 6310 – Conducting Wilderness Characteristics Inventory on BLM Lands and considered in the land use planning process under BLM Manual 6320 - Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process (BLM 2012b).

The Buffalo planning area contains three WSAs that have been previously inventoried and determined to possess wilderness characteristics (see the *Wilderness Study Areas* section of this chapter). The *Lands with Wilderness Characteristics* resource analysis is limited to areas outside of designated WSAs.

3.6.7.1. Regional Context

Initial inventories for lands potentially containing wilderness characteristics in the planning area were completed in 1978. Lands that clearly and obviously did not contain wilderness characteristics were then released from further consideration. In 1979, intensive inventories were completed for three areas in the Buffalo Field Office: Fortification Creek, Gardner Mountain, and North Fork. In the Buffalo Field Office, portions of these three areas were determined to meet the size and naturalness criterion and were submitted to Congress for protection as WSAs. All other parcels were determined to lack wilderness characteristics according to the 1979 report.

3.6.7.2. Indicators

A wilderness inventory evaluates wilderness characteristics as defined in Section 2(c) of the Wilderness Act of 1964, and incorporated in FLPMA. Guidelines for Inventory of Wilderness Characteristics are specified in BLM Manual 6310 – Conducting Wilderness Characteristics Inventory on BLM Lands. In order for an area to be classified as lands with wilderness characteristics (LWC), it must possess sufficient size (or meet size exception criteria), naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation. In addition, it may also possess supplemental values. While the BLM is precluded from establishing any new WSAs or modifying existing WSAs during the planning process (BLM 2012c), the agency is required to consider wilderness characteristics in the planning process. LWCs are managed under administrative prescriptions analyzed in a LUP, and are not Congressionally mandated.

3.6.7.3. Current Condition

In February 2004, the BLM received a document entitled *Wilderness at Risk-The Citizens' Wilderness Proposal for Wyoming BLM Lands* (Updated Version) submitted by a consortium of organizations led by the Wyoming Wilderness Association (Howell 2004), an updated version of a previous document known as the *Citizens' Wilderness Proposal* (Wyoming Wilderness Coalition 1994). The proposal requests additional acres surrounding each of the three existing WSAs be protected as wilderness.

The Wyoming Wilderness Coalition proposes:

- 7,133 acres be added to the existing Fortification Creek WSA
- 10,181 acres be added to the existing Gardner Mountain WSA
- 3,388 acres be added to the existing North Fork WSA

For each of the above proposals, the document summarizes the highlights, location and access, wilderness qualities, resource analysis, and proposes boundaries and management recommendations. In summary, the Citizens' Wilderness Proposal recommends additional acres in the Fortification Creek area for its "unique topography and truly western scenery;" additional acres in the Gardner Mountain area because of its "impressive historical legacy and terrific wildlife habitat;" and additional acres in the North Fork Powder River area for its "unsurpassed delicate beauty, impressive environment, and outstanding fishery" (Howell 2004).

All contiguous blocks of BLM-administered lands greater than 5,000 acres or potentially meeting exception criteria were assessed through interdisciplinary review (Map 61). Those parcels containing extensive oil and gas development, public roads, or having documentation of multiple constructed and maintained roads were eliminated from further consideration. Remaining parcels (Map 61) were inventoried for wilderness characteristics.

Fortification Creek Citizens' Wilderness Proposal

The Fortification Creek CWP was inventoried in the summer and fall of 2010. The CWP was separated into two sub-units for inventory purposes based on maintained roads and the configuration of the CWP in relation to the WSA. The Southeastern Sub-Unit totals approximately 1,705 acres and did not meet the size requirements or exceptions. Due to oil and gas activities and existing roads, the area did not appear to be natural. Because the Southeastern Sub-Unit did not meet the size or naturalness criterion, it was excluded from further analysis. The Western Sub-Unit totals approximately 5,420 acres and meets the size requirements for consideration. Due to water development activities and existing roads, the area did not appear to be natural. The configuration of the WSA and pervasive noises from activities outside of the WSA precluded outstanding opportunities for solitude or a primitive and unconfined type of recreation. It was therefore determined that the Fortification Creek CWP does not contain wilderness characteristics, and will not be carried forward in the alternative process.

Gardner Mountain Citizens' Wilderness Proposal and Adjacent BLM-Administered Lands

The Gardner Mountain CWP and additional contiguous BLM-administered lands were inventoried in 2011 and 2012. The CWP totals approximately 10,181 acres and meets the size requirements for consideration. BLM-administered lands outside of the CWP, including parcels between the CWP and Slip Road and parcels between Barnum Road and Brock Road, encompass approximately 13,000 acres. In total, the 23,380 acres inventoried in the Gardner Mountain region did not meet the naturalness criteria. It was therefore determined that the Gardner Mountain inventory unit does not contain wilderness characteristics, and will not be carried forward in the alternative process.

North Fork Citizens' Wilderness Proposal

The North Fork CWP and additional contiguous BLM-administered lands were inventoried in 2011 and 2012. The CWP totals approximately 3,470 acres as well as the WSA. Contiguous BLM-administered lands outside of the CWP, including the Horn encompass approximately 3,100 acres. In total, the 6,548 acres inventoried in the North Fork region did not meet the naturalness criteria. It was therefore determined that the North Fork inventory unit does not contain wilderness characteristics, and will not be carried forward in the alternative process.

New Acquisitions

The BLM has made several acquisitions since the 1985 RMP. The Welch Ranch (1,747 acres) does not meet the size or exception criteria and was not analyzed further. The BLM has acquired two parcels (Collins Land Exchange at Weston Hills and 60 Bar Exchange at Burnt Hollow Management Area) in northern Campbell County that resulted in BLM parcels meeting the size requirement and were considered for potential wilderness characteristics. However, historic oil and gas development, the presence of nearby state highways and county roads, and the current levels of motorized use at these two parcels led our interdisciplinary team to determine that further analysis was not necessary. The new acquisitions did not contain wilderness characteristics and therefore will not be carried forward in the alternative process.

3.6.7.4. Trends

Lands with wilderness characteristics are considered to be a diminishing resource nationwide. The planning area has experienced an increase in visitation and multiple uses with an emphasis on mineral extraction, agricultural use, and recreation opportunities. Regionally, the interest in areas with wilderness characteristics is increasing through visitation by recreationists who seek areas with such characteristics for their primitive and unconfined recreation opportunities and outstanding opportunities for solitude.

3.6.7.5. Key Features

The one LWC unit determined to possess wilderness characteristics located along the ridgeline of the southern Big Horn Mountains in Johnson County, Wyoming. The vegetation and topography include forest, meadows, rock-outcroppings, and steep mountain slopes. Elevations within the unit range from approximately 5,250 feet to 7,580 feet. Slopes exceed 30% in much of the area. Portions of this unit are designated as important to various wildlife, particularly elk.

Manageability of portions of the LWC unit may be difficult. The northern portion of the unit is adjacent to numerous summer homes and cabins, creating a wildland-urban interface that may require mechanical thinning to prevent wildfire. The Billy Creek Road is a cherry-stemmed route in the northwestern portion of the unit. The BLM manages a nonmotorized trail, the Poison Creek Trail, to provide hiking opportunities and access for anglers off of the Billy Creek Road. The unit is about 3.5 miles across at its widest point and approximately 0.25 mile wide at its narrowest sections in the southern portion. The unit consists of 12,237 acres of BLM surface with wilderness characteristics.

3.6.8. Livestock Grazing Management

The livestock and agricultural industry has a long and rich heritage in Wyoming. The precipitation levels, soils types and limitations, and topography make northeast Wyoming better suited to livestock grazing on the grasslands and shrublands than to cultivated agriculture (farming). Grazing on public lands represents a vital economic value to agricultural producers and to local communities. In addition, livestock grazing represents irreplaceable environmental and social values. Livestock have grazed on these allotments for more than 100 years. These values and traditions contribute important and irreplaceable wildlife habitat, open spaces, ranchland buffers between federal lands and developments, scenic vistas, visual beauty, and the traditional image and heritage of the historic rural landscapes of Wyoming and the U.S. West.

Livestock grazing can impact soil, plants, biological crusts, streams, and springs. Soils can be affected by hoof action that breaks up soil clumps and “plants” seeds in the soil. Grazing in hot dry seasons can substantially reduce biological soil crust cover causing soil erosion (Muscha and Hild 2006). Grazing also can compact soils if livestock are confined. Impacts to plants is primarily through removal of vegetative mass (leaves); this can invigorate plants to produce more and remove any old growth that if allowed to build up can stunt and inhibit plant growth. A healthy stand of vegetation holds and protects soils from wind and water erosion. This reduces soil sediments from entering streams and affecting water quality. Vegetation also helps hold banks of streams and spring areas to keep soil in place and reduce water erosion. Plants also help filter sediments, and such filtration improves water quality in streams and springs. Grazing management is designed to increase plant productivity and reduce soil erosion by controlling grazing through fencing and water projects and by balancing forage demands with the land’s productivity.

3.6.8.1. Regional Context

The BLM is responsible for administering livestock grazing on public land across the planning area. Livestock grazing includes the grazing of domestic animals (e.g., cattle, sheep, horses, yaks, and bison). All public land in the planning area is designated for grazing unless otherwise prohibited and is governed under Taylor Grazing Act Section 15, which concerns issuing grazing leases on public lands outside the original grazing district boundaries established by the Taylor

Grazing Act of 1934. Base property is land, owned or controlled by a BLM lessee, that may serve as a base for a livestock operations. The land must have the capability to produce crops or forage that can be used to support the livestock authorized for a specified period. The base property supporting a Section 15 grazing lease must adjoin the leased public lands unless no applicant owns adjoining lands. In most cases, the base property for a Section 15 lease adjoins, surrounds, or is intermingled with the leased public lands. Public lands comprise approximately 10% of the surface acres; the remaining 90% is a combination of private and state lands. The majority of lands with live water (streams and springs) were homesteaded and are private lands. Therefore, except for drilled water wells and associated stock water pipelines and constructed reservoirs, most of the water available for livestock and wildlife comes from private lands.

From 1949 through 1954, the BLM conducted a classification of public lands within the Buffalo Field Office as part of a regional effort generally referred to as the "Missouri River Basin Survey" (MRB). A large portion of the Buffalo Field Office was resurveyed in 1968. Through the MRB effort the Powder River Basin (Area 3) was inventoried for vegetation, capability, erosion and carrying capacity. The MRB survey determined ecological range condition for each range site on the basis of a comparison between the existing site vegetation versus what the site was originally (potentially) capable of producing. The process to estimate the available forage for livestock grazing was conducted by trained individuals and involved intensive vegetation sampling (clipping, weighing, and ocular estimation). The stocking rates for the majority of the grazing leases within the Buffalo Field Office are based on this inventory.

Most professional Rangeland Management Specialists that have worked in the Buffalo Field Office have felt that the authorized grazing use (animal unit month [AUM]) generated from the MRB was conservative. In the years since the MRB, the BLM has conducted supplemental Ecological Site Inventories and updated the authorized use on a few grazing allotments. In each of these cases, it was determined that the carrying capacity was higher than those resulting from the MRB. Forage produced from the public lands within the Buffalo Field Office area contribute approximately 110,000 AUMs or about 4% of the feed requirements for the livestock for all land ownerships. The Buffalo Resource Management Plan (RMP) approved October 4, 1985, and the 2001 update, state that "any permanent increases in the amount of forage produced are considered for wildlife and watershed protection before additional livestock use is authorized."

3.6.8.2. Indicators

The indicators for the livestock grazing program are an increase or decrease in available forage and/or an increase or decrease in AUM on BLM-administered lands.

Also, the BLM recognizes that AUM production on its rangelands can be sustained only with proper management of livestock grazing activities. To evaluate rangeland health and keep AUM production sustainable, the BLM utilizes the *Wyoming Standards for Healthy Rangelands* and *Guidelines for Livestock Grazing Management for Public Lands Administered by the Bureau of Land Management in the State of Wyoming* (BLM 1998).

In 1998 the BLM began assessing grazing allotments with these standards in accordance with the change in 1995 to the 43 CFR 4100 grazing regulations. Management decisions and actions are made in accordance with the *Wyoming Standards for Healthy Rangelands*. The BLM uses these standards to allow sustainable livestock grazing to continue while protecting watersheds, riparian and upland ecosystems, and wildlife habitat.

Standards address the health, productivity, and sustainability of BLM-administered public rangelands and represent the minimum acceptable health for public rangelands. The standards apply to all resource uses on public lands. Their application will be determined as resource-specific guidelines are developed. Standards are synonymous with goals and are observed on a landscape scale. They describe healthy rangelands rather than important rangeland by-products. The achievement of a standard is determined by observing, measuring, and monitoring appropriate indicators. An indicator is a component of a system the characteristics (e.g., presence, absence, quantity, and distribution) of which can be observed, measured, or monitored based on sound scientific principles.

3.6.8.3. Current Condition

In the planning area, public lands comprise approximately 10% of the surface acres; the remaining 90% is a combination of private and state lands. Due to this scattered land pattern, livestock operations and management are run as seamless units regardless of surface ownership. To separate public lands to be managed as special units would not be feasible for the grazing lessee or the BLM. The BLM manages livestock grazing on 782,102 acres in the planning area. This acreage incorporates 427 grazing leases (Table 3.47, "Summary of Livestock Type and Authorizations in the Buffalo Planning Area" (p. 441)) authorizing approximately 106,078 AUM of livestock forage in 477 grazing allotments. Four hundred livestock operators use public lands in the planning area in Johnson, Campbell, and Sheridan counties; most of these lands are in Johnson County. The Buffalo Field Office also administers grazing use for public lands within the boundaries of adjacent BLM Field Office planning areas through cooperative management agreements. Over the last 20 years (1989–2008), the lowest AUM allocation was in 2006 with a total of 89,297 AUM authorized, the highest was in 1997 with 108,607 AUM, the AUM annual authorization average is 98,278.

Table 3.47. Summary of Livestock Type and Authorizations in the Buffalo Planning Area

Livestock Type	Number of Leases
Cattle only	362
Sheep only	18
Cattle and sheep	24
Horses only	5
Bison only	2
Yak only	1
Cattle and horses	11
Cattle, sheep, and horses	4
Total	**427**
Source: BLM 2009a	

Livestock grazing on allotments is authorized during various times during the year depending on management objectives. Grazing periods vary with elevation and geographical change, resource needs, and user preference. The higher-elevation allotments are generally grazed during summer and fall. The lower-elevation areas can be grazed during any season. Most of the allotments in the planning area are operating with prescribed use levels that provide for plant recovery to enhance rangeland health. When rangelands are not meeting resource objectives, the BLM implements changes in grazing management.

In 1985, all allotments were placed in categories established by BLM range management policies, as follows: "I" (Improve), "M" (Maintenance), and "C" (Custodial). The BLM categorizes allotments according to the greatest potential for resource improvement and the greatest economic return for applied management. Factors in the categorization process include public land acreage, estimated range health and trend, resource conflict or concerns, existing grazing systems, range suitability, production potential, wildlife habitat values, land patterns and acreages, and range improvement needs. Allotments with larger tracts of public land and the highest potential were placed in the I and M categories; allotments with smaller tracts of public land were placed in the C category. The BLM gave priority to the I category allotments, followed by the M category allotments and then the C category allotments. Map 60 shows how the planning area has been categorized.

At present, 18 allotments in the planning area are operated under allotment management plans (AMPs) or management agreements (Table 3.48, "Activity Plans – Allotment Management Plans and Management Agreements" (p. 442)). AMP and grazing agreements usually incorporate a deferred rotation grazing system to allow periodic rest during the critical growing season for vegetation from initial spring green-up through seedset (March 1 to July 10).

Table 3.48. Activity Plans – Allotment Management Plans and Management Agreements

Allotment Number	Allotment Name	Type of Plan	Public Acres
22213	Tongue River	AMP	1,767
22214	Schooner Ranch	AMP	12,482
32014	North Windmill	AMP	2,074
02275	Remington Creek	AMP	2,676
02310	Little Willow	AMP	6,080
02344	Dry Vee	Agreement	4,442
02371	Slope/Mountain/Stubbs Draw/Poker Creek	AMP	16,540
02380	Wormwood Ranch/Beaver Creek	AMP	12,917
02390	Olmstead	AMP	832
02426	Crooked Creek	AMP	20,367
02430	Powder River	AMP	4,526
02438	T.W.	AMP	1,840
02476	Gardner Mountain (South)	AMP	1,622
12033	Red Fork	AMP	10,000
12139	Falxa	AMP	14,759
12162	Fence Creek	AMP	4,820
22106	Wagonhammer	AMP	3,881
		Total	**123,247**

Source: BLM 2009a

AMP Allotment management plan

The BLM assesses approximately 10% of the public land grazing allotments in the planning area annually. Where livestock grazing has been identified as contributing to an allotment not meeting the rangeland health standards, allotment-specific guidelines or BMPs are being implemented to improve rangeland health. The BLM monitors to ensure proper grazing on the allotments and uses monitoring results to determine if present management is adequate for meeting rangeland health requirements or if a change in management is needed. Changes in management that have been applied include the construction or implementations of range improvements to aid in livestock management. Range improvement projects can include construction of fences, water delivery systems, and water holding facilities; prescribed burning; and ensuring reliable water sources. It can also include cultural changes such as a change in livestock type, deferment of a portion or all of an allotment, change or limitation of the season of use, or leasing additional lands. The goal is to continue sustainable livestock use on public lands while maintaining healthy watersheds and providing habitat for wildlife.

At the end of fiscal year 2008, the BLM had completed rangeland health evaluations on 125 allotments comprising 588,581 acres of public land. The BLM determined that one or more rangeland health standards were not being met in three allotments (a total of 9,601 acres). Only a portion of those acres within the allotments did not meet rangeland health standards.

The BLM implements range improvement projects to help achieve management goals. Range improvement projects implemented before the 1960s were financed by the grazing lessees. Later, the BLM contributed funds to projects and in some cases fully financed them. There are numerous old projects on public lands that the BLM possibly did not authorize, primarily reservoirs and fences). In recent years the BLM has sought and participated in cost-shared projects with other agencies and private organizations to achieve mutual goals on public and private lands.

The Buffalo Field Office uses set criteria to prioritize new projects for funding. Highest priority is given to reconstruction of existing projects and new projects needed to implement rangeland health guidelines. Criteria used to rank other projects include implementation of activity plans; cooperatively funded projects; allotment category (I, stock driveway, M, and C); number of allotments benefited; project cost; number of AUM of forage authorized on an allotment; and wildlife habitat enhancement. Current BLM policy is to assign all maintenance responsibilities to the benefiting user, usually the grazing lessee.

Before 1997, an average of 6 to 10 range improvement projects were completed annually. Since 1998, an average of four to six range improvement projects have been completed annually. These projects consist primarily of fences, stock-water pipelines, spring developments, water wells, and vegetative treatments (Table 3.49, “Range Improvement Projects Implemented in the Buffalo Planning Area, Wyoming Since 1998” (p. 443)).

Table 3.49. Range Improvement Projects Implemented in the Buffalo Planning Area, Wyoming Since 1998

Type of Project	Number Projects Projected	Projects Completed Since 1998
Fences (miles)	3.3	21
Reservoirs (number)	1	0
Springs (number)	2	7
Wells (number)	3	2
Pipelines (number)	5	10
Source: BLM 2008a		

3.6.8.4. Trends

Livestock grazing will continue in the planning area in response to public demand. Many livestock operators in the planning area depend on the forage public lands provide. A predicted increase in development of mineral resources in the planning area will increase the presence of energy development-related infrastructure and machinery (e.g., roads, pipelines, well pads, processing facilities, and a variety of vehicular traffic). Construction of new facilities and related infrastructure necessary to extract mineral resources will require removal of existing vegetation. Further indirect loss of available forage could occur as increased infrastructure and traffic constrain livestock movements. As reclamation practices are applied to the public lands, the BLM could adjust livestock numbers and locations to ensure the success of those applications.

Evaluation of rangeland health will continue, with a focus at the allotment level. The emphasis will change somewhat from focusing only on high-priority allotments to focusing on all public lands, especially those with potential Greater Sage-Grouse habitat and habitat for other species at risk. The BLM would still adjust grazing use at the allotment level. Table 3.50, “Animal Unit Months Authorized in the Planning Area” (p. 444) lists AUM authorized in the Buffalo planning area.

Table 3.50. Animal Unit Months Authorized in the Planning Area

Year	Campbell County	Johnson County	Sheridan County	Field Office Total
1989	34,096	52,862	5,103	92,061
1990	34,505	55,024	5,359	90,068
1991	33,234	59,281	4,796	97,311
1992	32,860	61,078	5,145	99,083
1993	34,170	60,733	5,292	100,195
1994	35,075	66,601	5,601	107,277
1995	35,698	58,825	5,423	99,946
1996	36,368	59,865	5,107	101,340
1997	37,118	66,041	5,448	108,607
1998	35,454	68,230	4,908	108,592
1999	34,558	61,912	5,727	102,197
2000	36,288	64,756	5,290	106,334
2001	32,229	59,472	4,985	96,686
2002	34,365	55,740	4,722	94,827
2003	33,216	58,487	5,274	96,977
2004	33,446	56,802	5,071	95,319
2005	34,751	49,864	5,677	90,292
2006	34,511	48,638	6,148	89,297
2007	35,382	49,811	6,444	91,637
2008	38,597	53,066	5,848	97,511
Average	34,796.05	58,354.4	5,127.4	98,277.85
Source: BLM 2008g				

Recent agricultural land sales suggest that there is general stability in agricultural land uses and the ownership of agricultural properties. Future demand for agricultural land in Johnson, Sheridan, and Campbell counties and the State of Wyoming can be expected from persons seeking a rural lifestyle in either part- or full-time agricultural activities. Some existing agricultural operations might choose to expand by acquiring additional lands. Agricultural property sizes will vary, depending on the buyers' financial resources, lifestyles, and preferences and their intended uses of the property.

Developers often are attracted to better agricultural land because its topography makes it more economical to develop. This also can result in the reduction of agricultural land and the decline of the quality of life in northeast Wyoming.

3.6.8.5. Key Features

Key features for livestock grazing include I and M category allotments and crucial habitat areas for wildlife and special status species, and recreational sites.

3.7. Special Designations

The planning area contains proposed Areas of Critical Environmental Concern (ACEC), proposed Scenic and Back Country Byways (BCBs), a waterway that is suitable and eligible for Wild and Scenic River (WSR) designation and three Wilderness Study Areas, discussed below. The planning area does not contain designated or proposed National Scenic and Historic Trails, National Recreation Trails or National Water Trails and these designations will not be discussed further.

3.7.1. Areas of Critical Environmental Concern

3.7.1.1. Regional Context

FLPMA section 103(a) defines an Area of Critical Environmental Concern (ACEC) as an area within public lands where special management attention is required to protect and prevent irreparable damage to important historical, cultural, and scenic values, fish and wildlife, and natural systems or processes, and to protect human life and safety from natural hazards. ACEC implementation regulations are 43 CFR 1610.7-2(b).

The land use planning process may officially designate an area found to meet ACEC criteria and would specify the special management direction needed to protect the relevant and important resource values. While the Buffalo Field Office does not currently have any designated ACECs, there are several areas that meet the relevant and important criteria.

3.7.1.2. Indicators

Before an area is nominated for ACEC designation, it must meet both the relevance and importance criteria (43 CFR 1610.7-2 and BLM Manual 1613) to become eligible for further consideration. An area would meet the relevance criteria if it contains one or more of the following: a significant historic, cultural, or scenic value; a fish or wildlife resource; a natural process or system; or natural hazards. An area would meet the importance criteria if it is characterized by one or more of the following: qualities or circumstances that make it fragile, sensitive, irreplaceable, rare, unique, etc.; more than locally significant qualities; warrants protection to satisfy national priority concerns or to carry out FLPMA mandates; qualities that warrant concern for safety and public welfare; or poses a significant threat to human life and safety or to property.

3.7.1.3. Current Condition

The public nominated seven areas for ACEC designation in 2002 (Koepsel 2002). The Notice of Intent for BLM's national Greater Sage-Grouse Planning Strategy (WO IM-2012-044) invited the public to nominate or recommend areas on public lands for Greater Sage-Grouse and their habitat to be considered as ACECs. Several nominations were received. Through the scoping process, numerous nominations were presented. It is also BLM policy to evaluate newly acquired lands, such as Burnt Hollow and the Welch Ranch to determine if they meet the ACEC criteria.

Potential Areas for Consideration as ACECs

Seven public nominated ACECs and the Cow Creek Breaks (Burnt Hollow) acquisition were initially analyzed in the Powder River Basin Final EIS (BLM 2003c). Six of the nominations were determined to meet the ACEC criteria. BLM also concluded that current management was sufficient to protect the relevant and important criteria but deferred any designation decisions until such time an amendment specific to their designation or revision of the Buffalo RMP is conducted (BLM 2003c). The areas evaluated in the PRB FEIS include Cantonment Reno, Burnt Hollow, Dry Creek Petrified Tree, Face of the Bighorns, Fortification Creek Elk Area, Hell's Half Acre, Hole-In-The-Wall, and Pumpkin Buttes. Of these, the Face of the Bighorns and Hell's Half Acre were determined not to meet the criteria and were eliminated from further consideration. In addition to the areas identified in the 2003 PRB FEIS, the Welch Ranch parcel, acquired in 2003, also merits consideration for designation as an ACEC. Finally, an ACEC to conserve the fragile sagebrush ecosystem in also being evaluated. Table 3.51, “Evaluation of ACEC Relevance and Importance Criteria” (p. 447) lists the citizen's ACEC proposals meeting BLM criteria, new acquisitions, and areas internally identified for further review, and the BLM determinations regarding relevance and importance.

Table 3.51. Evaluation of ACEC Relevance and Importance Criteria

Proposed ACECs	Relevance Criteria	Importance Criteria
Cantonment Reno	Significant historic values (Pioneer history and associated with Bozeman Trail).	Regional and national significance (one of few forts from the time period on public land); vulnerable to adverse change (unauthorized excavation).
Burnt Hollow	Scenic values; geologic features and natural hazards (steep erosive soils prone to flooding).	Public and management concerns for safety (flood potential).
Dry Creek Petrified Tree	Rare geologic features (excellent paleontological specimens on a site with public access).	Regional significance; fragile and irreplaceable qualities (paleontological specimens) which are vulnerable to adverse change.
Fortification Creek Elk Area	Scenic values and wildlife resources (yearlong, calving and crucial winter range of plains-based elk herd).	Rare qualities (plains-based elk herd) which are vulnerable to adverse change (high mineral potential); warrants protection to meet national priority concerns.
Hole-In-The-Wall	Significant historic (western lore associated with Butch Cassidy) and scenic values (panoramic views of the Red Wall/South Big Horns).	Distinctive historical and interpretive qualities; public concerns for management.
Pumpkin Buttes	Significant cultural and historic values (religious and cultural importance to Native Americans; used by early pioneers as a landmark destination); scenic values and unique geologic features (erosional remnants forming high buttes east of the Powder River).	Regional and national significance (Native American religious and cultural values) which are vulnerable to adverse change (wind and uranium potential; communication site).
Sagebrush Ecosystem	Significant wildlife values (Greater Sage-Grouse and other rare or special status sagebrush obligates) and natural systems (sagebrush ecosystem).	Sagebrush ecosystems are fragile and sensitive systems that provide essential habitat for several special status and rare species. Greater Sage-Grouse conservation is a national priority, and the proposed ACEC has been recognized as appropriate to maintaining sustainable Greater Sage-Grouse populations.
Welch Ranch	Important scenic value, important fish and wildlife resource, and presence of a natural hazard (active coal seam fire).	More than locally important qualities that give it special worth; coal seam fire creates management concerns about safety and public welfare.
ACEC Area of Critical Environmental Concern		

3.7.1.4. Trends

The PRB FEIS (BLM 2003c) analyzed all of the potential ACECs with the exception of the Sagebrush Ecosystem and Welch Ranch. The PRB FEIS concluded that present management was sufficient to protect the relevant and important ACEC values. The PRB FEIS was an oil and gas project and therefore did not analyze all potential land use activities affecting ACEC values. Land uses such as renewable energy development, ROWs, and other mineral development could adversely affect ACEC values.

3.7.1.5. Key Features

Burnt Hollow (Cow Creek Breaks)

The Burnt Hollow Management Area is a recently acquired parcel totaling nearly 18,000 acres of

BLM-administered lands in northern Campbell County. The varied topography and diversity of vegetative communities is unique and provide habitat for numerous wildlife species including trophy class mule deer. A few of the ephemeral drainages support ecologically important cottonwood riparian communities. The area is comprised of gently rolling sagebrush-grasslands, ponderosa pine and juniper woodlands, scoria buttes, and clayey escarpments. Portions are roadless due to steep terrain and unstable soils. The lands are presently used for livestock grazing and wildlife habitat; mineral development is limited to a few abandoned drill holes. Cultural resources are also present in the area. Twenty-three cultural properties have been recorded in the vicinity. One occupation site has been determined eligible for listing on the NRHP; another is of unknown eligibility. Other prehistoric and historic era sites are known to exist in the area, but have not yet been recorded. The area is approximately 20 miles north of Gillette on Wyoming Highway 59. Most importantly, the area is one of the largest blocks of contiguous public land in Campbell County, and one of the only parcels in the county that possesses the size and naturalness to accommodate primitive and unconfined nonmotorized recreational opportunities.

The area meets the relevance criteria for scenic value and presence of a natural hazard due to steep erosive soils and flooding potential. Burnt Hollow meets the importance criteria because of public and management concerns about safety and public welfare (flooding potential) (BLM 2003c, Appendix R).

Cantonment Reno

Cantonment Reno is a 523 acre parcel on BLM surface on the site of a historic military supply fort established in 1876 on the Bozeman Trail. The fort had the capacity to house more than 350 soldiers and contained quarters, kitchens, mess houses, a hospital, storage buildings, and specialized facilities for cavalry. It was used as a supply depot for military campaigns, primarily against the Northern Cheyenne during the winter of 1876 to 1877. The U.S. Army abandoned the cantonment in 1878. The site retains well-defined features (foundations), contains numerous buried artifacts, and is noteworthy for the large amount of intact archeological information it contains. Hundreds of documents relating to the fort are on file at the National Archives, presenting numerous opportunities to answer research questions through site excavation.

Although there is no public access, there has been unauthorized excavation and collection at the site. The location is on a floodplain of the Powder River and might soon be exposed to erosion from an encroaching oxbow bend. The fluid minerals under the site have been leased, but there is a no surface occupancy stipulation for the entire proposed ACEC. There is extensive CBNG development a few miles to the east.

Cantonment Reno is the only military fort from the period of the Great Sioux War on BLM surface in the United States. The site meets relevance criteria because it is a rare and sensitive archeological resource. The site also meets importance criteria because it is directly associated with nationally significant historic events (the Great Sioux War), has qualities that give it significant special worth and distinctiveness, and has qualities that make it fragile and vulnerable to adverse change (BLM 2003c, Appendix R).

Dry Creek Petrified Tree

The Dry Creek Petrified Tree area is a 2,567-acre parcel that includes exposed specimens of petrified trees within a 40-acre environmental education site approximately 8 miles east of Buffalo. The site has public access, an interpretive trail, an outhouse, and a picnic shelter with tables. Tourists, local schools, and hunters use the area. The area is a PFYC Class 5 Area and contains excellent paleontological specimens.

The area meets relevance criteria for unique geologic feature and importance criteria for regional significance (used as an educational and tourist attraction) and fragile and irreplaceable qualities (paleontological specimens) which are vulnerable to adverse change (unauthorized removal of specimens) (BLM 2003c, Appendix R).

Fortification Creek Elk Area

The Fortification Creek area meets relevance criteria for scenic value and as a wildlife resource. It also meets the importance criteria for rare qualities (plains-based elk herd) which are vulnerable to adverse change (high mineral potential). The BLM deferred a decision on the citizen nomination within the Powder River Basin FEIS (BLM 2003c) concluding that management was sufficient to protect the relevant and importance criteria. The Decision Record for the 2011 Fortification Creek RMPA/EA (BLM 2011c) made a final determination on the citizen nomination, again concluding that management was sufficient to protect the relevant and importance criteria. The Decision Record also identified that the citizen proposed boundary did not adequately represent the resources for which the ACEC was nominated. To better represent the relevant and important resource values, the boundary evaluated in the RMP revision is the BLM-administered lands within the crucial seasonal ranges (calving areas and crucial winter range).

The Fortification Creek area is comprised of rough prairie break topography bisected by several drainages. Typical vegetation is sagebrush-grassland intermixed with juniper. Elk were historically present in the area but were extirpated in the late 1800s. Today, a herd of approximately 200 elk resides year-round in the area as a result of reintroductions in the 1950s. The elk herd and its habitat is being encroached upon by CBNG development. The Fortification Creek area also contains a WSA, scenic values, steep slopes, highly erodible soils, and fragile watersheds (BLM 2003c, Appendix R).

Hole-In-The-Wall

Hole-in-the-Wall is approximately 20 miles southwest of Kaycee, Wyoming. It is a colorful and scenic red sandstone escarpment rich in legend of outlaw activity in the late 1800s, most notably Butch Cassidy and the Wild Bunch Gang. The "hole" is a gap in the Red Wall that, legend has it, outlaws secretly used to move horses and cattle from the area. The BLM has not identified or documented any historic sites on BLM surface in the area. Many of the historic features are on private lands and several key artifacts have been removed and placed in regional museums. However, the area remains a popular destination for travelers from outside the region and for commercial tours due to the recognizable name, notoriety, and relevance in western lore. The area is primitive in nature, with few visitor services. The BLM recently implemented several actions (creating a public viewing and parking area and trail head and installing interpretive signs) to protect the site and allow for public access.

Hole-in-the-Wall meets the relevance criteria for significant historical or cultural values and scenic value. The site meets the importance criteria for having distinctive historical and interpretive qualities; public concerns for management (BLM 2003c, Appendix R).

Pumpkin Buttes

Pumpkin Buttes is approximately 45 miles southwest of Gillette, rising approximately 800 feet above the surrounding landscape. The buttes consist of five flat-topped mesas referred to as North Butte, North Middle Butte, South Middle Butte, South Butte, and Indian Butte. The BLM administers most of the mineral estate under the buttes. All of South Middle Butte and half of North Middle Butte are BLM surface. There is no public access to the BLM surface on either butte, although the BLM purchased an administrative easement to South Middle Butte. South

Middle Butte is currently used as a communications site and includes six transmission towers. There are numerous mining claims for uranium or other minerals on and near the buttes, with one proposed uranium mining operation on BLM surface on North Middle Butte. There is extensive CBNG development around the buttes, and an existing oil field within 3 miles. A 200 turbine wind-energy development has been proposed on fee surface within 2 miles of the east side of the buttes.

Recent consultations with Native American tribes revealed that the buttes were utilized for many types of traditional, religious and ceremonial purposes. Indications of traditional and religious uses (e.g., stone circles, eagle traps, and cairns) remain on most of the buttes. In 2007, the BLM determined in consultation with 15 tribes that the Pumpkin Buttes has an ongoing connection to traditional beliefs and practices of several Native American tribes and designated the buttes as a TCP. During the consultation process, the tribes expressed a continued interest in using the buttes for ceremonial or educational purposes.

Pumpkin Buttes is also a prominent landmark associated with several historic events. All of the explorers of the Powder River Basin in the early and mid 19th Century mention the buttes in their journals. Jim Bridger is credited with naming Pumpkin Buttes in the 1850s. The buttes also are mentioned as a landmark in several emigrant diaries from travelers on the Bozeman Trail in the 1860s. The buttes had a role in Red Cloud's War and the Great Sioux War, as a lookout for the U.S. Army and Native American tribes.

The site meets the relevance criteria because it contains several rare and sensitive archeological resources, and is a significant religious and cultural resource important to several Native American tribes. The site meets the importance criteria because it has qualities that give it significant special worth and distinctiveness. The area also has qualities that make it fragile, sensitive, irreplaceable, and vulnerable to adverse change. The area also meets the importance criteria because it warrants protection to carry out FLPMA mandates (BLM 2003c, Appendix R).

Sagebrush Ecosystem

The Notice of Intent for BLM's national Greater Sage-Grouse Planning Strategy (WO IM-2012-044) invited the public to nominate or recommend areas on public lands for Greater Sage-Grouse and their habitat to be considered as ACECs. Numerous nominations were received. Greater Sage-Grouse are a management indicator species for sagebrush ecosystem health, meaning that they are dependent upon sagebrush ecosystems at a landscape scale for their survival and managing Greater Sage-Grouse habitat would conserve other rare and special status sagebrush dependent species. Greater Sage-Grouse populations have the greatest chance of persisting when landscapes are dominated by sagebrush and natural or human disturbances are minimal (Aldridge et al. 2008; Knick and Hanser 2011; Wisdom et al. 2011). The Buffalo Field Office is evaluating the public lands within 4.0 miles of Greater Sage-Grouse leks and winter concentration areas, an area of 467,897 acres or 60% of the BLM surface within the planning area. Management within 4 miles of critical habitat features is consistent with the National Technical Team recommendations (Taylor et al. 2012) for Greater Sage-Grouse conservation.

A sagebrush ecosystem ACEC meets relevance characteristics for conserving wildlife resource values and natural systems. Sagebrush ecosystems provide essential habitat that support several BLM special status species including the Greater Sage-Grouse, an Endangered Species Act Candidate species. Additional BLM sensitive species dependent upon sagebrush ecosystems, and present within the planning area, include: Brewer's sparrow, sage sparrow, and sage thrasher. Sagebrush ecosystems are terrestrial plant communities that support multiple resources (soil, water, native vegetation, biodiversity, rare and sensitive species, etc.) and land uses (recreation, livestock grazing, etc.) for which the BLM is responsible for sustainable management.

A sagebrush ecosystem ACEC meets importance characteristics for protecting a natural system and for meeting national priorities. Sagebrush ecosystems are fragile and sensitive systems that provide essential habitat for several special status or rare species. Sagebrush ecosystems and the rare and sensitive species that they support are vulnerable to adverse change. Sagebrush ecosystems have been fragmented in the planning area by energy development particularly CBNG. Greater Sage-Grouse conservation is a national priority, and the proposed ACEC has been recognized as appropriate to maintaining sustainable Greater Sage-Grouse populations. The Powder River Basin provides important genetic linkage between population strong holds in Montana (Management Zone 1) and the Wyoming basins (Management Zone 2).

Welch Ranch

The Welch Ranch Management Area is a 1,748-acre parcel approximately 10 miles north of Sheridan, Wyoming, along State Highway 338. The BLM acquired Welch Ranch in 2004 as part of a land exchange (BLM 2005f). As a new acquisition, the BLM must evaluate the area as a potential ACEC. At least two homesteads (the Tryor homestead and the Evans homestead) were present on the property, which also historically included a post office. There also is evidence of prehistoric use, including lithic scatters and quarries. Current and historic uses include grazing; current management provides grazing from November through April. Approximately 1.5 miles of the Tongue River runs through the Welch Ranch. The riparian corridor is important migratory bird habitat and boasts excellent habitat for mule deer and other big game. The Tongue River is a red ribbon fishery, meaning it has regional importance. A free-flowing prairie river with easy public access from a major population center in Wyoming is extremely rare. Without special designation and management, public recreation visitation will degrade the importance and relevance criteria. Increased public awareness of riparian health will assist to improve the habitat through cooperative efforts and increase the species diversity and numbers of birds to the point that the area will be acknowledged as an Important Bird Area.

There is an active coal seam fire on a ridge in the southwestern corner of Welch Ranch. Historic records indicate that the coal seam fire began approximately around 1940 (BLM 2003b), and while the origin is unclear, the fire is now considered to be part of the natural process. The Office of Surface Mining and specialists within the BLM have voiced concerns regarding human health and safety in relation to the coal seam fire and has suggested that special management might be necessary to prevent unsafe exposure to this hazard. Proposed abatement would have resulted in undue and unnecessary environmental degradation and was not expected to completely extinguish the fire.

The area meets the relevance criteria for scenic value, a fish and wildlife resource, and presence of a natural hazard (coal seam fire). The coal seam fire on the north side of the river is an important resource because it represents a threat to health and safety, influences plant and animal distribution and form, and represents historical mining operations. There are no known injuries from public interaction with the fire vents. Welch Ranch meets the importance criteria because it has more than locally important qualities that give it special worth and there are management concerns about safety and public welfare. Prairie riparian habitats represent less than one percent of the planning area. The Welch Ranch constitutes one of very few BLM-administered riparian areas and one of the few areas in Sheridan County with public access for fishing and boating. The combination of the rarity of the riparian habitat type, the accessibility of the location in near a population center, and high recreational use underscore the importance of Welch Ranch.

3.7.2. Scenic or Back Country Byways

3.7.2.1. Regional Context

The BLM began a National Back Country Byway Program in 1989 to focus on enhancing recreational opportunities. A National Scenic Byway System was subsequently created under Section 1047 of the Intermodal Surface Transportation Efficiency Act of 1991. This act recognized the BLM National Back Country Byway Program as a component of the National Scenic Byway System (section 1032, eligible projects). The objectives of the byway program include the following:

- Enhance opportunities for the American public to see and enjoy the unique scenic and historical opportunities on public lands.
- Foster partnerships at local, state, and national levels.
- Contribute to local economies.
- Enhance the visitor's recreation experience and communicate the multiuse management message through effective interpretative programs.
- Manage visitor use along the byway to minimize impacts to the environment and to protect visitors.
- Contribute to the National Scenic Byway System in a way that is uniquely suited to BLM-administered national public lands.

Transportation corridors with high scenic, historic, archeological, or other public-interest values are eligible for inclusion in the National Scenic Byway System. Byways are nominated through a collaborative process and are usually designated through RMPs. Proposed byways must have attractions important on a state and national basis. Many have recreational, historical, wildlife, educational, scientific, or cultural features. The entire route must have legal access. All state, federal, and local agencies with jurisdiction over road segments of the byway must agree to the designation.

While there are no BLM-administered National Byways within the planning area, there is one BLM-administered Back Country Byway, and another byway being evaluated just outside the planning area boundaries. The South Big Horns/Red Wall National Back Country Byway, administered by the Casper Field Office, traverses the South Big Horn Mountains in northwest Natrona County. The Worland Field Office is currently evaluating the Hazelton Road within Washakie County as a potential Back Country Byway in their RMP revision. Within the planning area there are three Scenic Byways administered by the Bighorn National Forest: Bighorn Scenic Byway (US 14), Cloud Peak Scenic Byway (US 16), and Medicine Wheel Passage Scenic Byway (US 14A).

3.7.2.2. Indicators

Management indicators would be the ability to meet the objectives for which the individual byways were designated.

3.7.2.3. Current Condition

At present, there are no BLM-administered National Byways in the planning area; six routes will be evaluated.

- **Hazelton Road** – This route traverses the spine of the Big Horn Mountains in western Johnson County from US 16 south to the Washakie County line (33 miles). If designated within the Buffalo and Worland Field Offices, the Hazeloton byway would connect the Cloud Peak Scenic Byway to the South Big Horns/Red Wall National Back Country Byway. The route has a mixed land tenure including private (64%), BLM (18%), Bighorn National Forest (16%), and lands managed by the State of Wyoming (2%).

- **Slip Road** – A 15 mile route providing access to the southern Big Horn Mountains from Mayoworth northwest of Kaycee. The route is a stock driveway, and with the exception of 0.5 mile of state land the entire route is on BLM surface. The western terminus is the proposed Hazelton Back Country Byway.

- **Trabing and Sussex Roads** – These two routes follow 44 miles of the Bozeman Trail through southern Johnson County connecting Interstate 25 in the north to WY 192 in the south. There are several interpretive displays related to the Bozeman Trail along the route. The route has a mixed ownership including private (83%), BLM (11%), and lands managed by the State of Wyoming (6%).

- **Powder River Road** – This route parallels the Powder River for 73 miles from Interstate 90 to the Montana State line. The route has a mixed land tenure including private (88%), BLM (11%), and lands managed by the State of Wyoming (1%).

- **Rome Hill** – This is a short (3 miles) route in southwestern Johnson County running west from the proposed Hazelton Back Country Byway to the Washakie County line. The route has a mixed land tenure including private (82%), BLM (15%), and lands managed by the State of Wyoming (3%). Rome Hill Road is not being evaluated as a potential Back Country Byway in the Worland RMP revision.

- **Tipperary and Thompson Creek Roads** – This 37 mile route passes through mixed prairie and break landforms in eastern Johnson and Sheridan Counties connecting Interstate 90 with US 14/16. The route provides access to the Dry Creek Petrified Tree Environmental Education Area and parallels a portion of lower Crazy Woman Creek. The route has a mixed land tenure including private (94%), BLM (3%), and lands managed by the State of Wyoming (3%).

All routes are natural surfaced well maintained routes passable to passenger vehicles.

3.7.2.4. Trends

National Byways were a popular program at the time of their creation. Funding has substantially decreased in recent years, popularity of the program has waned with the decreased funding. Byways appeal to the increasing segment of the public engaging in vehicle touring that prefers less traveled scenic back country routes to highway travel.

3.7.2.5. Key Features

The six routes exhibit the potential for designation as National Back Country or Scenic Byways. Public support and cooperation with the appropriate counties would be essential to designate any routes.

3.7.3. Wild and Scenic Rivers

3.7.3.1. Regional Context

In 1968, Congress passed the Wild and Scenic Rivers Act, thereby establishing the National Wild and Scenic Rivers (WSR) System for the purpose of preserving rivers with outstanding remarkable values in a free-flowing condition for the benefit of present and future generations. The BLM was subsequently directed to evaluate waterways and provide recommendations of which public waterways under its administration meet the criteria for designation as WSRs (BLM 2012d). The WSR System is a system of congressionally designated rivers and their immediate environments that have outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, and other similar values and are preserved in a free-flowing condition. The system consists of three types of rivers, as follows:

- Recreation – Rivers or sections of rivers that are readily accessible by road or railroad and that might have some development along their shorelines and might have undergone some impoundments or diversion in the past
- Scenic – Rivers or sections of rivers free of impoundments, with shorelines or watersheds still largely undeveloped but accessible in places by roads
- Wild – Rivers or sections of rivers free of impoundments and generally inaccessible except by trails, with watersheds or shorelines essentially primitive and waters unpolluted

The BLM is responsible for evaluating all rivers on BLM-administered land to determine if they are appropriate for addition to the System and, as appropriate, making recommendations for legislative actions to accomplish such additions. River or stream segments must be found eligible and suitable to be considered for designation as WSRs, and only Congress can designate segments.

3.7.3.2. Indicators

WSRs must meet certain eligibility and suitability criteria. According to BLM Manual 6400 – Wild and Scenic Rivers, to be eligible for designation as a WSR, a waterway must be free-flowing and it must possess one or more of the following outstandingly remarkable values: scenery, recreation, geology, fish, wildlife, historical, cultural, or other similar values. To be further considered for designation, a waterway must meet suitability requirements related to manageability, land tenure status, reasonably foreseeable potential uses of the river corridor, and considerations of cost of management.

3.7.3.3. Current Condition

The Buffalo Field Office completed an assessment of all waterways within the planning area in 1993 and 1994 (BLM 2001a) and documented the findings in Appendix G of the 2001 RMP Update. A WSR Final Review Report was completed for the planning area in 2003 (BLM 2003d). Four waterways were determined to be eligible for WSR designation: Beartrap Creek, Middle Fork Powder River, North Fork Powder River, and Powder River (Cantonment Reno). However, only the Middle Fork Powder River was determined to be eligible and suitable for WSR designation (BLM 2001) (Table 3.52, "Middle Fork Powder River Wild and Scenic River Characteristics" (p. 455)).

Table 3.52. Middle Fork Powder River Wild and Scenic River Characteristics

Suitable for Wild and Scenic River status (miles)	Classification	Current management	Mineral potential, leasable	Mineral potential, locatable	Mineral potential, salable
11.25 miles in Buffalo Field Office **Note: an additional ~1.2 miles of suitable and eligible waterway extends into the Worland Field Office	Wild	Managed for non-impairment under BLM Manual 6400	Low	Low; the portion within the Ed O. Taylor has been withdrawn from mineral entry	Very low
Source: BLM 2012f BLM Bureau of Land Management					

3.7.3.4. Trends

A site-specific interim management plan is in place to maintain the wild and scenic characteristics of the Middle Fork Powder River. Proposals to dam the Middle Fork Powder River have been submitted in the past, but have not been pursued and are not currently reasonably foreseeable.

3.7.3.5. Key Features

The BLM has determined that a portion of the Middle Fork Powder River (11.25 miles; 2,664 acres) meets the WSR suitability factors and should be managed to maintain or enhance their outstandingly remarkable values (BLM 2001a). The interim management prescriptions for suitable waterways in the Buffalo RMP planning area apply only to the waterway corridor of 11.25 miles of the Middle Fork Powder River and includes the waterway area, its immediate environment, and an average of no more than one quarter mile (1,320 feet) from the ordinary high water mark on both sides of the waterway. This boundary is preliminary and, by Section 3(b) of the WSRA, may vary on either side of the waterway and be narrower or wider as long as the total corridor width averages no more than 320 acres (half of a mile or 2,640 feet wide) per river mile, and can be delineated by legally identifiable lines (e.g., survey or property lines) or some form of on-the-ground physical feature (e.g., canyon rims, roads, etc.) which provide the basis for protecting the waterway's outstandingly remarkable values. Since the suitable waterway within the Buffalo RMP planning area (i.e., Middle Fork Powder River) is located within a deep canyon that is capable of both supporting and protecting the identified outstandingly remarkable values, corridor boundaries for the Middle Fork Powder River are delineated by the canyon rims, except in cases where "rim-to-rim" exceeds an average of a half mile. Final boundary delineation would be made if and when Congress decides to designate the waterway segments under review.

The public lands along all 11.25 miles are tentatively classified as wild. Interim management practices for the BLM-administered parcels along the Middle Fork Powder River meeting the wild classification will focus on maintaining or enhancing the outstandingly remarkable scenic, recreational, cultural, historic, fishery, and wildlife values and maintaining the relatively primitive, pristine, rugged, and unaltered character of the area.

3.7.4. Wilderness Study Areas

3.7.4.1. Regional Context

In 1964, Congress passed the Wilderness Act, thereby establishing the National Wilderness Preservation System for the purpose of preserving lands in a natural condition for the benefit of present and future generations. Through FLPMA (Section 603), Congress directed the BLM to inventory, study, and recommend which public lands under its administration should be designated as Wilderness.

WSAs are areas determined to meet Wilderness eligibility requirements but for which Congress has not acted on the managing agency's recommendation. WSAs often have special qualities, such as ecological, geological, educational, historic, scientific, and scenic values. They are managed in accordance with BLM Manual 6330 – Management of Wilderness Study Areas to prevent impairment of wilderness characteristics until Congress acts to designate such areas as Wilderness or release the areas from further study.

3.7.4.2. Indicators

WSAs must be managed in such a manner as to preserve unimpaired their wilderness characteristics as discussed in Section 2(c) of the Wilderness Act of 1964, and incorporated in FLPMA (Section 603), which states: "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

The BLM performed inventories of roadless areas in the planning area in 1979 and made recommendations to Congress of areas potentially suitable for designation as Wilderness. These recommendations are based on factors such as the manageability of the area, how well it meets the characteristics of wilderness, conflicts or potential for conflicts with other users and uses, and other relevant factors.

3.7.4.3. Current Condition

While there are no congressionally designated Wilderness areas in the planning area, the Buffalo Field Office does manage three WSAs. The three BLM-administered WSAs in the planning area include Gardner Mountain, North Fork Powder River, and Fortification Creek (Map 63).

The BLM completed the Wyoming Statewide Wilderness Study Report in 1991 (BLM 1991). In this study, the BLM inventoried and documented the features of all WSAs in Wyoming. In addition, each WSA was recommended or not recommended for designation as Wilderness.

Regardless of the BLM recommendation, all WSAs included in the 1991 report continue to be managed as WSAs and must be addressed as WSAs in RMP revisions.

The BLM recommendations were incorporated in the 1985 Buffalo RMP. As of October 1, 2012, Congress had not acted on these recommendations. Congress requires the BLM to manage WSAs to preserve the wilderness characteristics under the non-impairment standard until Congress designates the lands under wilderness review as Wilderness, or releases the lands to uses other than Wilderness.

3.7.4.4. Trends

Congress has not taken action on the WSAs within the planning area since 1979. Given the historic, regional and political context of wilderness, Congress is not expected to take action regarding the WSAs during the life of this plan. BLM management continues to manage the WSAs within the Buffalo planning area to the non-impairment standard.

3.7.4.5. Key Features

Gardner Mountain WSA (WY-060-201)

The Gardner Mountain WSA, which encompasses approximately 6,423 acres with no state or private inholdings, is in Johnson County 40 miles southwest of Buffalo. The area is characterized by the rugged terrain of the southern Big Horn Mountains and dominated by ponderosa pine, Douglas fir, limber pine, scattered mountain mahogany, and meadows. Deep, steep-walled canyons of Beartrap Creek and the North Fork of the Red Fork Powder River are the dominant perennial water sources. The area provides winter habitat for elk and mule deer and other wildlife resources including mountain lions, black bears, turkeys, blue grouse, golden eagles, and red-tailed hawks, among others. Solitude, excellent fishing opportunities, wildlife-based recreation, historic landscapes, and naturalness are some of the wilderness opportunities in this WSA.

North Fork Powder River WSA (WY-060-202)

The North Fork Powder River WSA, which encompasses approximately 10,089 acres with no state or private in holdings, is in Johnson County 30 miles southwest of Buffalo. The area is dominated by two deep, rugged and scenic canyons – Pass Creek and North Fork Powder River. Vegetation in the steep terrain is dominated by ponderosa pine, Douglas fir, and limber pine, while mixed with open, native-grass covered areas. The area provides winter range for elk, is a pronghorn migration route, and provides habitat for black bear and a variety of other species and raptors. Solitude, excellent fishing opportunities, primitive and unconfined recreation, and naturalness are some of the wilderness opportunities in this WSA.

Fortification Creek WSA (WY-060-204)

The Fortification Creek WSA, which encompasses approximately 12,419 acres of public lands and one state-owned in holding of 640 acres, is 36 miles northeast of Buffalo in northeastern Johnson County and northwestern Campbell County. The area is representative of the Sagebrush Steppe ecosystem/Great Plains Shortgrass Prairie province. This ecosystem is not found in any designated wilderness. The landscape is steeply sloping, highly dissected, and gullied terrain. The main drainages are Bull Creek, Little Bull Creek, and Deer Creek. Vegetation consists of juniper, sagebrush, and grasses. Most of the WSA is considered crucial for elk, which use the area for winter and calving range because of the available forage and cover. Solitude, primitive and unconfined recreation, naturalness and unique landscapes are some of the wilderness opportunities in this WSA.

3.8. Socioeconomic Resources

3.8.1. Social Conditions

Social conditions concern the human communities in the planning area, including towns, cities, and rural areas; the customs, culture, and history of the area as it relates to human settlement; and current social values.

This section describes population and demographics, customs, culture, and social trends.

3.8.1.1. Current Condition

Population and Demographics

Table 3.53, “Population Change by County, 1970-2010” (p. 458) summarizes population information for the planning area counties in 1970 and 2010; Table 3.54, “Populations of Towns in the Planning Area in 2000 and 2010” (p. 458) lists populations for towns in the planning area in 2000 and 2010. The most populous county in the planning area is Campbell County, with more than 46,000 residents in 2010. Sheridan County had approximately 29,000 residents and Johnson County had approximately 8,500. The most populous cities in the planning area, in order of decreasing size, are Gillette (Campbell County), Sheridan (Sheridan County), and Buffalo (Johnson County).

Table 3.53. Population Change by County, 1970-2010

Area	Population in 1970	Population in 2010	Percent Change 1970-2010	Average Annual Percent Change 1970-2010
Campbell County	13,049	46,133	254	3.2
Johnson County	5,611	8,569	53	1.1
Sheridan County	17,865	29,116	63	1.2
Wyoming	333,795	563,626	69	1.3
United States	203,798,722	308,745,538	52	1.0
Sources: Bureau of Economic Analysis 2009; U.S. Census Bureau 2012				

Table 3.54. Populations of Towns in the Planning Area in 2000 and 2010

Town	Population in 2000	Population in 2010	Percent Change 2000-2010	Average Annual Percent Change 2000-2010
Arvada	33	43	30.3%	2.7%
Big Horn	198	490	147.5%	9.5%
Buffalo	3,900	4585	17.6%	1.6%
Clearmont	115	142	23.5%	2.1%
Dayton	678	757	11.7%	1.1%
Gillette	19,646	29,087	48.1%	4.0%
Kaycee	249	263	5.6%	0.5%

Town	Population in 2000	Population in 2010	Percent Change 2000-2010	Average Annual Percent Change 2000-2010
Parkman	137	151	10.2%	1.0%
Ranchester	701	855	22.0%	2.0%
Sheridan	15,804	17,444	10.4%	1.0%
Story	887	828	-6.7%	-0.7%
Wright	1,347	1,807	34.1%	3.0%
Sources: U.S. Census Bureau 2000; U.S. Census Bureau 2010b n/a not available				

Table 3.55, “Age Distribution by County, 2010” (p. 459) lists information about the population distribution by various age groups in 2010. Johnson and Sheridan counties had a slightly older age distribution than Campbell County, Wyoming, or the United States, as reflected in a higher median age, and a lower proportion of residents in the younger age categories and a greater proportion in the older age categories.

Table 3.55. Age Distribution by County, 2010

Area	Median Age	Percent of People by Age Category				
		Under 18	18 to 24	25 to 44	45 to 64	65 and Over
Campbell County	31.9	28	10	30	27	6
Johnson County	44.8	22	6	22	31	19
Sheridan County	41.9	22	8	23	31	16
Wyoming	36.8	24	10	26	28	12
United States	37.2	24	10	27	26	13
Source: U.S. Census Bureau 2012						

Table 3.56, “Educational Attainment in 2010” (p. 459) summarizes educational attainment in each county in 2010. Compared to the United States, people in the counties in the planning area are more likely to have a high school diploma, but less likely to have a 4-year college degree. Johnson County has the highest percentage of high school graduates and the highest percentage of 4-year college graduates. Among the three counties, Campbell County has the lowest percentage of 4-year college graduates.

Table 3.56. Educational Attainment in 2010

Area	Percent of People Age 25 and Over	
	High School Diploma	4-year College Degree
Campbell County	91.0	17.6
Johnson County	94.6	25.3
Sheridan County	92.7	23.1
Wyoming	91.3	23.6
United States	85.0	27.9
Source: U.S. Census Bureau 2010a		

3.8.1.2. Trends

Customs, Culture, and Social Trends

This section describes the social development, culture, and history of the planning area to provide insight into how changes in the planning area might affect the livelihood and quality of residential life.

The first people to live in the planning area were Native American Tribes, including the Crow, Lakota/Dakota, Arapaho, Kiowa, Comanche, Blackfeet, Cheyenne, and Shoshone. The first European-American or white people in the area arrived in the early 1800s and included fur trappers, traders, and explorers (Johnson County 2005). Fur trapping became more prevalent in the 1820s and 1830s, but no large or permanent settlements had been built by the mid-1800s. Clashes between the United States military and the Native Americans increased in frequency and intensity in the 1860s and 1870s, due in part to the increased number of European-American migrants and settlers traversing the area (Johnson County 2005). A series of treaties in the late 1860s provided that the Lakota (Sioux) would be allowed to live on all of the land that is now Campbell County, along with the Powder River country and the Black Hills (Johnson County 2005; Campbell County 2007b). However, less than 10 years later the U.S. government decided to restrict the Lakota and other northern Plains tribes to smaller reservations so that the land could be opened for non-native settlers. After the U.S. military defeated and evicted the northern Plains Indians, white settlement began in the vicinity of the planning area in the late 1870s and early 1880s.

Johnson County was created in 1879, and included all of the land that is now Johnson County and Sheridan County and parts of present-day Big Horn and Washakie counties. Sheridan County was split off in 1887. Campbell County was created in 1911 from Weston and Crook counties. Homesteaders and ranchers comprised most of the first settlers. Oil exploration and production activities begin in the planning area in the late 1880s, primarily in parts of Campbell County and in the Salt Creek Basin of Johnson County. Increased exploration activities by various companies in the Salt Creek Basin eventually led to the development of oil camps in neighboring Natrona County (Johnson County 2005). As settlement increased through the early 20th Century, mining, railroading, and agriculture formed the basis of the economy.

In 1923, Carter Oil Company developed some commercial quantities of natural gas in the Billy Creek field southwest of Buffalo, and from 1948 to 1956 several additional fields in Johnson County came into production (Johnson County 2005). However, oil production in Campbell County started relatively late, and in 1954 there was only one producing well in the entire county. Therefore, in Campbell County, agriculture continued as the largest employer until oil drillers discovered the vast Powder River Basin resources in the 1960s (Campbell County 2007b). Campbell County experienced a boom in oil development and production during the late 1960s and early 1970s; coal development followed almost on the heels of the oil boom. The late 1980s and early 1990s saw the beginning of CBNG development, which continues (Johnson County 2005; Campbell County 2007b). Other minerals, including uranium and bentonite, have been important contributors to the economic development of the planning area. One of Wyoming's three major production areas of swelling bentonite is along the flanks of the Big Horn Mountains (Johnson County 2005).

The use of natural resources on private, state, and federal lands provides the basis for continued social and economic stability in all three counties in the planning area. Agriculture, mining, mineral development and production, and tourism are directly related to the ability to use federal and state lands. Therefore, management decisions for federal lands and natural resources will have a ripple effect throughout the social and economic climate of the planning area (Campbell County 2007b).

All three counties in the planning area have comprehensive land use plans that address existing and planned or hoped-for future conditions of transportation infrastructure and other elements. The Campbell County plan does not identify any issues associated with transportation infrastructure, although it does make clear that the county government will work to preserve ROW for private property owners (Campbell County 2007b). The Johnson County plan notes that all county roads are functioning at acceptable levels of service, but also notes that one road (French Creek Road) extending northwest from Buffalo carries substantial traffic due to numerous subdivisions along that route. The plan predicts that due to new subdivisions planned along this corridor, maintenance and improvements of this road are expected to be issues of concern (Johnson County 2005). The Sheridan County plan identifies several new roadways proposed for the future, primarily around the towns of Big Horn and Sheridan, and an extensive network of bicycle trails and paths (Sheridan County 2008).

For other types of community infrastructure, including law enforcement, schools, and medical care, the Johnson County plan identifies a need for additional county government office space and a new law enforcement center (Johnson County 2005). The Sheridan County plan notes that rural areas in the county typically lack physical infrastructure such as sewer and water lines, and states that future development will occur only in areas that have the physical infrastructure to support it (Sheridan County 2008). It does not identify specific areas of deficient services in urban areas. The Campbell County plan does not address these types of community infrastructure.

The Wyoming Economic Analysis Division (2010a; 2010b) provides forecasts of population for planning area counties and some towns. Table 3.57, "Population Forecasts through 2030" (p. 461) summarizes available information from this source. The data suggest that Campbell County will grow fastest, with a growth rate double that of the state. Johnson County will also grow above the rate of the state as a whole, with Buffalo and Kaycee growing about as fast as the rest of the county. Sheridan County will continue to grow at a rate below that of the state as a whole.

Table 3.57. Population Forecasts through 2030

Area	Population (Actual or Forecasted)				Percent Change 2010-2030	
	2000	2010	2020	2030	Overall	Average Annual
Campbell County	33,698	46,133	56,890	66,060	43	1.8
Gillette	19,646	29,087	35,869	41,651	43	1.8
Wright	1,347	1,807	2,228	2,588	43	1.8
Johnson County	7,075	8,569	9,450	10,450	22	1.0
Buffalo	3,900	4,585	5,056	5,591	22	1.0
Kaycee	249	263	290	321	22	1.0
Sheridan County	26,560	29,116	31,380	33,520	15	0.7
Clearmont	115	142	153	163	15	0.7
Dayton	678	757	816	872	15	0.7
Ranchester	701	855	921	984	15	0.7
Sheridan	15,804	17,444	18,800	20,083	15	0.7
Wyoming	493,782	563,626	622,360	668,830	19	0.9
Sources: Wyoming Economic Analysis Division 2010a; Wyoming Economic Analysis Division 2010b						

The Johnson, Campbell, and Sheridan comprehensive plans discuss forecasted conditions and planned coordination to varying degrees. The most important element for BLM purpose in this analysis is that all three counties emphasize the importance of coordination with the BLM and other federal land management agencies. For example, the Sheridan County plan states that the county will cooperate with and provide guidance to federal and state agencies that manage land and resources regarding regional issues of concern, including social and economic issues (e.g., substantial natural resource development) and others (e.g., water quality from CBNG development) (Sheridan County 2009). The Johnson County plan identifies three key concerns related to BLM-administered land and resources, all related to the continued availability of public lands for livestock grazing and the policies that affect the management of federal grazing allotments (Johnson County 2005). The Campbell County plan calls on federal and state land managers to recognize the customs, culture, economic viability, social structure, and quality of life of the citizens of Campbell County in their planning actions (Campbell County 2007b).

Note that federal law (43 CFR 1610.3) requires the BLM to prepare plans that are consistent with officially adopted local land use plans, identify inconsistencies with proposed BLM plans and local plans to the Governor, and take practical steps to resolve conflicts between federal and local plans. These requirements apply only if local governments notify the BLM that a local land use plan has been adopted (Johnson County 2005).

3.8.2. Economic Conditions

Economic analysis is concerned with the production, distribution, and consumption of goods and services. This section summarizes economic information, including trends and current conditions, for the planning area. It also identifies and describes major economic sectors in the planning area that can be affected by BLM management actions.

Economic conditions in individual communities in the planning area are integrally linked to those of other communities, both inside and outside the planning area. For example, businesses in some cities outside the planning area, such as Billings and Casper, provide services and labor to CBNG developers in the planning area. Similarly, some of the people who recreate in the Big Horn Mountains and other areas come from outside the planning area. Therefore, economic conditions outside the planning area indirectly affect the economy in the planning area, and BLM management actions in the planning area can affect economic conditions outside the planning area. Because of these linkages, and due to the relative importance of CBNG development in the economy of the larger region outside the planning area, the AMS for economic conditions considers areas outside the planning area when addressing some elements of the analysis. Therefore, this section includes some data for three nearby counties (Natrona County in Wyoming, and Big Horn and Yellowstone counties in Montana).

<u>Economic Activity and Output</u>

This section provides a brief overview of industries most affected by BLM land management policies and programs in the planning area — mining (including oil and gas), travel, tourism and recreation, and livestock grazing. The sections that address personal income, employment, and tax revenues provide additional information and data about jobs, earnings, and tax revenues contributed by these economic sectors.

3.8.2.1. Current Conditions

Mining, Including Oil and Gas

Mining and mineral production constitutes most of the economic activity in the planning area. Table 3.58, "Estimated Mineral Production and Value by County in the Buffalo Planning Area in 2010" (p. 463) summarizes the quantity and value of mining production in the counties in the planning area, and for the state as a whole, in 2010. Economically, the largest contributors to mining activity are oil and coal in Campbell County, and gas in all three counties. Most coal produced in Wyoming in 2010 was from Campbell County, and almost one-third of the sand and gravel produced in the state was from the three planning area counties. The *Mineral Resources* section of this chapter provides additional information about mineral resources in the planning area.

Because the BLM administers subsurface mineral resources in excess of the surface lands it administers, its decisions impact mining in the planning area (see the *Mineral Resources* section for more detail). From an economic perspective, mining is a key contributor to the economic wellbeing of the planning area; therefore, BLM management decisions in this area could impact economic conditions.

Table 3.58. Estimated Mineral Production and Value by County in the Buffalo Planning Area in 2010

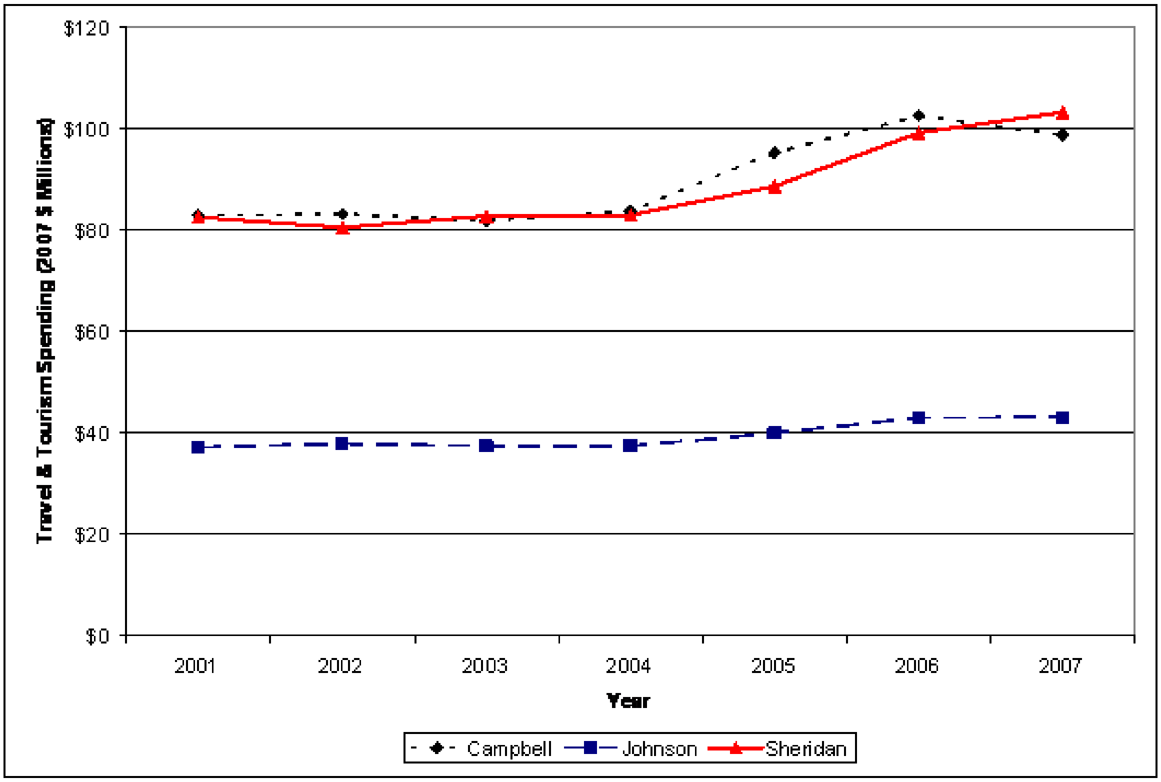
Mineral	Campbell County	Johnson County	Sheridan County	Wyoming
Production or Sales (units)				
Oil (barrels sold)	6,395,812	539,283	6,103	37,410,583
Gas (thousand cubic feet sold)	137,140,505	349,220,009	52,323,923	2,429,249,686
Coal (tons)	401,618,421	0	0	438,751,440
Uranium (pounds produced)	0	0	0	1,711,712
Sand and gravel (tons)	2,630,827	728,238	245,755	11,993,124
Bentonite (tons)	0	412,654	0	4,453,282
Decorative stone (tons)	0	67	0	5,959
Taxable Valuation ($ millions)				
Oil	397	33	0	2,332
Gas	432	1,023	172	7,601
Coal	3,528		0	4,020
Uranium	0	0	0	33
Sand and gravel	4	1	0	23
Bentonite	0	3	0	64
Decorative stone	0	0	0	0
Source: Wyoming Department of Revenue 2011. Data are for year 2010.				

Travel, Tourism, and Recreation

Federal lands in the planning area provide a broad spectrum of outdoor opportunities for planning area residents and visitors. Recreation on public lands also provides economic benefits. Recreation service providers (e.g., hotels, outfitters, equipment manufacturers and dealers, and restaurants) depend on public lands, in part, for their livelihood. The approximately 800,000 acres of BLM surface in the planning area receive approximately 31,400 visits per year (BLM 2008a). Most recreational users of BLM surface are Wyoming residents. The towns of Sheridan, Buffalo, Gillette, Wright, and Kaycee all have public lands bordering them that are used as "backyard" recreation areas by local residents. However, visitors from outside Wyoming come to the planning area from all over the United States and from international locations. Visitors to the planning area come because of the central location (with Yellowstone National Park and the Bighorn National

Forest to the west, Montana to the north, the Black Hills to the east, and Colorado to the south) and the historic and cultural resources. Hunting, fishing, target shooting, and vehicle touring are among the most common recreational activities on BLM-administered lands in the planning area. Therefore, BLM-administered lands contribute to economic values in the planning area, albeit mainly for local residents and those traveling through to use recreational areas administered by the USFS, the National Park Service, or other agencies.

Figure 3.21, "Travel and Tourism Spending in the Planning Area" (p. 464) shows travel and tourism spending in the planning area. In real terms, travel and tourism spending was steady from 2000 to 2004 and increased slightly from 2004 to 2006, with some decline after 2006, more pronounced in Sheridan County. The figure does not distinguish travel for business from travel for pleasure; however, a recent study by the Wyoming Office of Travel and Tourism indicates that statewide in recent years, most trips (e.g., 98% in 2006) are due to tourism for pleasure (Wyoming Travel and Tourism 2007).



Source: Dean Runyan Associates 2006; adjusted for inflation using Wyoming Economic Analysis Division 2012a

Figure 3.21. Travel and Tourism Spending in the Planning Area

Livestock Grazing

The BLM is responsible for administering livestock grazing on public land surface across the planning area. Livestock grazing includes the grazing of domestic animals (e.g., cattle, sheep, horses, yaks, and bison). The Buffalo Field Office manages livestock grazing on 782,102 acres. This acreage incorporates 427 grazing leases, authorizing approximately 106,078 AUMs of livestock forage in 477 grazing allotments. Four hundred livestock operators use public lands in the planning area in Campbell, Johnson, and Sheridan counties; most of the public lands are in

Johnson County. The Buffalo Field Office also administers grazing use for public lands within the boundaries of adjacent BLM Field Offices through cooperative management agreements.

Livestock grazing on allotments is authorized during various times during the year depending on management objectives. In addition to the allotments, the Buffalo Field Office manages two major stock driveway systems – Kaycee (28.5 miles) and Hazelton Road (51.2 miles). These two stock driveways include segments of other trails, which for administrative purposes are considered part of the main stock driveway. The stock driveways are mostly fenced lanes.

BLM-administered grazing allotments are leased at lower fees on average than state or private lands. The federal grazing fee has been kept at $1.35 per AUM from 2007 to 2012 (Vincent 2012). For comparison, grazing fees on state land were $4.78 per AUM in 2006, $5.17 per AUM in 2007, and $5.21 in 2008 (Pannell 2008). The average grazing rate on privately owned non-irrigated land in Wyoming was $16.00 per AUM in 2009, $16.64 in 2010, and $15.70 in 2008 (National Agricultural Statistics 2011).

However, the lower lease fees correspond to potentially greater use restrictions and responsibilities for the lessee. For example, federal grazing leases typically restrict the number and species of animals that may be grazed, while on private leases, there is normally no penalty for grazing more than the agreed-upon numbers of animals (USFS and BLM 1992). However, if running more animals on a private lease results in overgrazing, the landowner might not be willing to renew the lease, because if the lessee fails to maintain the condition of the property the agreement can be terminated (USFS and BLM 1992). Federal leases also tend to be less flexible than private leases regarding adjusting turnout and roundup dates (USFS and BLM 1992). In addition, there are differences in relation to construction and maintenance of rangeland improvements such as fences and water developments, although a perfect comparison is not possible because there are different specifications that vary for specific private leases. On federal leases, construction of improvements can be done in a variety of ways, and expenses other than materials could be the responsibility of the lessee; the lessee also is generally responsible for maintaining the improvements. On private leases, the landowner typically bears a substantial part of the cost of major range improvements and typically pays for revegetation (USFS and BLM 1992).

In addition, lessees on privately held land may have more influence in negotiating agreements related to access and land development. For instance, in some cases lessees have the ability to help negotiate any agreements regarding a Plan of Development for oil or gas exploration or production, and depending on the agreement may receive surface damage payments from an oil and gas operator. Lessees of private land may also have more ability to negotiate over public access to the land they lease.

Taylor et al. (2004) analyzed the importance of BLM-administered land for livestock grazing in nearby Fremont County using a simulated enterprise-level ranch budget. Taylor et al. (2004) stated that most ranches typically depend only partially on federal land grazing for forage, but this forage source is a critical part of their livestock operations because of the seasonal dependency, even when the proportion of acres of AUMs contributed by federal land grazing is relatively small for the operation. Much of a ranch's private land is used as hay ground to produce hay for winter feeding. Using hay acreage to feed cattle during the summer means a ranch has to purchase hay for the winter. The rigidity of seasonal forage availability means that the optimal use of other forages and resources are affected when federal AUMs are not available (Taylor et al. 2004). These authors and many others in studies they reviewed from 1975 through 2002 found that potential reductions in income and net ranch returns are greater than the direct economic loss from reductions in federal grazing.

Table 3.59, “Farm Income in 2011” (p. 466) summarizes farm income in the planning area counties. In all three counties, livestock and livestock products contribute the most of the gross farm income (at least 74%). Government payments contribute a very small amount. Although gross income in the three counties together amounted to $152 million in 2011, net income after expenses was negative in all three counties (and marginally positive in Campbell County if the variation in the value of inventories is considered). This fact highlights the marginal profitability of farm and ranch operations in the planning area counties, and suggests that even apparently small changes in BLM forage, other resources available to farms and ranches, or prices for inputs or products could adversely impact their viability.

Table 3.59. Farm Income in 2011

Farm Income (2011 $ thousands)	Campbell County	Johnson County	Sheridan County
Gross income ($)	51,877	38,540	61,996
Percent of income from livestock	79	74	76
Percent of income from crops	10	9	15
Percent of income from other sources[1]	8	17	9
Percent of income from government payments	4	1	1
Net income ($)	-4005	-7,897	-22,858
Net income including inventory change ($)	213	-5,411	-19,171

Source: Bureau of Economic Analysis 2012a

[1]Includes the value of home consumption and other farm-related income components, such as machine hire and custom work income and income from forest products. This category also includes royalty payments from oil and gas producers to farmers when oil and gas development occurs on farm lands (Kennedy 2008).

Personal Income

This section describes personal income in the planning area. Table 3.60, “Personal Income and Earnings by Place of Work, 2011” (p. 468) summarizes the sources of personal income by place of work and county in the planning area. The table highlights county-level differences in the importance of various economic sectors, and the contribution of non-wage income, specifically dividends, interest, and rent, to personal income. In Campbell County, mining contributes almost two-fifths of total earnings by place of work, which is almost three times the contribution of any other sector. The next largest sectors are government (14%) and construction (9%). Campbell County also has a relatively low contribution from non-wage income and half of that of Johnson and Sheridan counties. Johnson and Sheridan counties have a relatively large share of income from mining; it is the third largest sector in both counties, with government employment contributing the largest share in each county followed by construction.

In all three counties, farm income contributes a very small share of earnings; in 2011, net farm income was negative in all three counties owing to expenses that exceeded gross income (Table 3.59, “Farm Income in 2011” (p. 466)). Agricultural services, such as custom tillage, may contribute as well, but the amount is no more than 2% in each of the three planning area counties.

The Bureau of Economic Analysis (BEA) data used to create Table 3.60, “Personal Income and Earnings by Place of Work, 2011” (p. 468) do not readily distinguish recreation earnings because these earnings can occur in a variety of sectors, including retail trade, accommodation and food services, and hunting, fishing, and trapping (included in the same row as logging and agricultural services). Subsequent tables and text provide available information on expenditures and sales tax receipts from activities related to travel and tourism, which serve as the closest approximation for recreation.

Table 3.60. Personal Income and Earnings by Place of Work, 2011

Item/Sector	Campbell County (Wyoming)	Johnson County (Wyoming)	Sheridan County (Wyoming)	Natrona County (Wyoming)	Big Horn County (Montana)	Yellowstone County (Montana)	Wyoming	United States
Population	46,618	8,642	29,239	76,366	13,093	150,069	568,158	311,591,917
Total personal income ($ millions)	2,218	352	1,485	4,132	351	5,949	27,214	12,949,905
Dividends, interest, and rent as a percent of total personal income	17	34	34	23	12	18	24	16
Earnings by place of work ($ millions)[1]	2,114	185	804	2,984	264	4,504	19,112	9,454,199
Percent of total earnings by place of work by sector								
Farming	0	1	0	0	84	0.3	1	1
Fishing, logging, and related activities, including agricultural services[2]	0	2	1	n/a	n/a	0	0	0
Mining	38	8	4	18	20	2	16	1
Utilities	2	1	1	n/a	2	1	2	1
Construction	9	16	10	9	2	8	9	5
Manufacturing	2	1	2	4	1	7	4	10
Wholesale trade	7	2	2	8	1	8	3	5
Retail trade	4	6	8	6	3	8	6	6
Transportation and warehousing	5	5	8	5	2	5	5	3
Information	0	1	1	1	0	1	1	3
Finance and insurance	1	2	2	3	2	5	3	8
Real estate and rental and leasing	1	2	3	0	0	1	2	2
Professional and technical services	3	4	6	5	1	7	4	10
Management of companies and enterprises	2	0	0	1	n/a	1	1	2
Administrative and waste services	2	1	2	2	n/a	4	2	4
Educational services	0	n/a	0	0	n/a	1	0	2
Health care and social assistance	3	n/a	11	13	n/a	17	7	11

Item/Sector	Campbell County (Wyoming)	Johnson County (Wyoming)	Sheridan County (Wyoming)	Natrona County (Wyoming)	Big Horn County (Montana)	Yellowstone County (Montana)	Wyoming	United States
Arts, entertainment, and recreation	0	2	1	1	1	1	1	1
Accommodation and food services	2	5	4	3	2	4	4	3
Other services, except public administration	4	4	4	5	2	4	3	4
Government and government enterprises	14	31	28	13	46	14	24	18
Categories for which data were not disclosed	1	1	1	1	1	1	1	1

Source: Bureau of Economic Analysis 2012a; Bureau of Economic Analysis 2012b

[1]Earnings by place of work differs from total personal income by the exclusion of dividends, interest, and rent, as well as adjustments to account for net transfer payments (e.g., unemployment benefits and Social Security taxes and payments) and the residential adjustment.
[2]"Related activities" includes hunting and trapping, as well as agricultural services such as custom tillage.
[3]Data were not disclosed due to confidentiality reasons (BEA does not report data when there are three or fewer employers in a sector). The line item "Categories for which data were not disclosed" shows the total income attributable to these categories for each county.

n/a not available

Table 3.61, "Earnings and Employment for Mining Activities (2010)" (p. 470) provides a summary of mining-related earnings and employment for the planning area counties for 2010. As the table shows, coal mining accounts for the majority of mining employment in Campbell County, while mining support activities are important in all three counties. Oil and gas extraction and related support activities contribute some employment and earnings in all three counties, principally Campbell and Sheridan.

Table 3.61. Earnings and Employment for Mining Activities (2010)

Source	Campbell County		Johnson County		Sheridan County	
	Payroll ($)[1]	Employees	Payroll ($)[1]	Employees	Payroll ($)	Employees
Mining	575,010,000	7,571	5,199,000	111	12,661,000	246
Oil and gas extraction	71,928,000	798	n/a[2]	0 to 19	9,353,000	178
Mining (except oil and gas)	428,407,000	5,503	n/a[2]	20 to 99	n/a[2]	0 to 19
Coal mining	428,407,000	5,503	0	0	0	0
Metal ore mining	0	0	0	0	0	0
Nonmetallic mineral mining and quarrying	0	0	n/a[2]	20 to 99	n/a[2]	0 to 19
Mining support activities	74,675,000	1,270	4,221,000	87	3,162,000	20 to 99
Drilling oil and gas wells	27,092,000	482	1,439,000	0 to 19	759,000	25
Oil and gas operations support activities	44,490,000	718	2,749,000	20 to 99	2,356,000	20 to 99
Support activities for coal mining	2,825	62	n/a[2]	0 to 19	0	0
Support activities for metal mining	n/a[2]	0 to 19	0	0	0	0
Nonmetallic minerals support activity (except fuels)	n/a[2]	0 to 19	0	0	n/a[2]	0 to 19

Source: U.S. Census Bureau 2010c. Number of employees is for week ending March 12, 2010. Payroll data are for the entire year.

[1]For most sectors, the data source reveals a range rather than an exact number of employees so as not to disclose confidential business information (because there are relatively few employers in the sector).
[2]The data source does not reveal data on payrolls for this sector due to confidentiality requirements (there are relatively few employers in the sector).

n/a not available

Employment

Table 3.62, "Employment by Sector, 2011" (p. 472) summarizes employment by sector for the counties in the planning area. The breakout is comparable to the earnings table above, with substantial portions of employment derived from mining, construction, and government. However, the differences between the two tables highlight the divergence in earnings per job in different sectors. For example, whereas mining contributes 38% of earnings in Campbell County, it contributes proportionally fewer jobs (27%), which illustrates the relatively high wages per job in the mining sector in that county. Similarly, retail trade accounts for 9% of jobs in Johnson County and 11% of jobs in Sheridan County, but contributes just 6% of earnings in Johnson County and 8% in Sheridan County. This divergence indicates that wages per job in this sector are relatively low, either because of lower wages per hour or because some jobs in the sector are seasonal or part-time.

Table 3.62. Employment by Sector, 2011

Sector	Campbell County (Wyoming)	Johnson County (Wyoming)	Sheridan County (Wyoming)	Natrona County (Wyoming)	Big Horn County (Montana)	Yellowstone County (Montana)	Wyoming	United States
Farm employment (%)	2	7	4	1	11	1	3	1
Fishing, hunting, logging, and related activities, including agricultural services (%)[1]	0	2	1	n/a	n/a	0	1	0
Mining (%)	27	8	4	11	11	1	9	1
Utilities (%)	1	0	0	n/a	1	0	1	0
Construction (%)	9	9	8	7	2	7	7	5
Manufacturing (%)	2	1	2	4	1	3	3	7
Wholesale trade (%)	5	2	2	5	1	6	3	3
Retail trade (%)	8	9	11	11	6	12	10	10
Transportation and warehousing (%)	4	3	4	3	2	4	4	3
Information (%)	1	1	1	1	0	1	1	2
Finance and insurance (%)	2	5	5	4	2	5	4	5
Real estate and rental and leasing (%)	2	8	5	5	1	4	5	4
Professional and technical services (%)	3	4	6	5	2	6	4	7
Management of companies and enterprises (%)	1	n/a	0	0	n/a	1	0	1
Administrative and waste services (%)	3	3	3	4	n/a	6	3	6
Educational services (%)	0	n/a	1	1	n/a	1	1	2
Health care and social assistance (%)	4	n/a	9	12	n/a	13	7	11
Arts, entertainment, and recreation (%)	1	2	2	2	2	3	2	2
Accommodation and food services (%)	6	9	8	7	5	8	8	7
Other services, except public administration (%)	5	4	5	6	4	6	5	6
Government and government enterprises (%)	15	17	18	11	38	10	19	14
Categories for which data were not disclosed (%)	0	5	0	1	10	0	0	0

Sector	Campbell County (Wyoming)	Johnson County (Wyoming)	Sheridan County (Wyoming)	Natrona County (Wyoming)	Big Horn County (Montana)	Yellowstone County (Montana)	Wyoming	United States
Total employment (number of jobs)	32,446	6,013	19,782	54,254	6,432	101,958	391,484	175,834,700

Source: Bureau of Economic Analysis 2012a; Bureau of Economic Analysis 2012b

[1]"Related activities" includes hunting and trapping, as well as agricultural services such as custom tillage

n/a not available

Table 3.63, “Average and Median Income; Average Earnings Per Job” (p. 474) shows three different measures of earnings and income for the planning area counties using the most recent available data. Average earnings per job are highest in Campbell County, as is median household income; in Johnson and Sheridan counties, both of these measures are lower than in Wyoming and average earnings per job are lower than in the United States. Per capita income, however, is higher in all three counties than the national figure, and is highest in Sheridan County. The relative difference between average earnings per job (which measures employment income only) and per capita income (which also includes dividends, interest, rent, and transfer payments such as Social Security) in Johnson and Sheridan counties underscores the importance of non-wage income in these counties, which is also identified above in the earnings data.

Table 3.63. Average and Median Income; Average Earnings Per Job

Area	Per Capita Income (2011) ($)	Average Earnings Per Job (2011) ($)	Median Household Income (2011) ($)
Campbell County	47,584	56,270	70,438
Johnson County	40,786	33,358	53,577
Sheridan County	50,803	38,866	53,217
Wyoming	47,898	44,033	56,044
United States	41,560	48,301	50,502
Sources: Bureau of Economic Analysis 2012a (per capita income and average earnings per job); U.S. Census Bureau 2011b (median household income)			

Table 3.64, “Unemployment Rate in 2008 through April 2011 (Percent)” (p. 474) lists the unemployment rate for counties in the planning area compared to state and national levels. As the table shows, unemployment in the planning area counties from 2008 through April 2011 was lower than in the United States and comparable to the statewide rate (slightly higher in Johnson, and lower in Campbell and Sheridan counties). Unemployment in Campbell County has remained lower than the statewide rate by approximately one percentage point. The unemployment rate was highest in 2010 in the planning area, Wyoming, and in the country as a whole, and fell slightly in 2011.

Table 3.64. Unemployment Rate in 2008 through April 2011 (Percent)

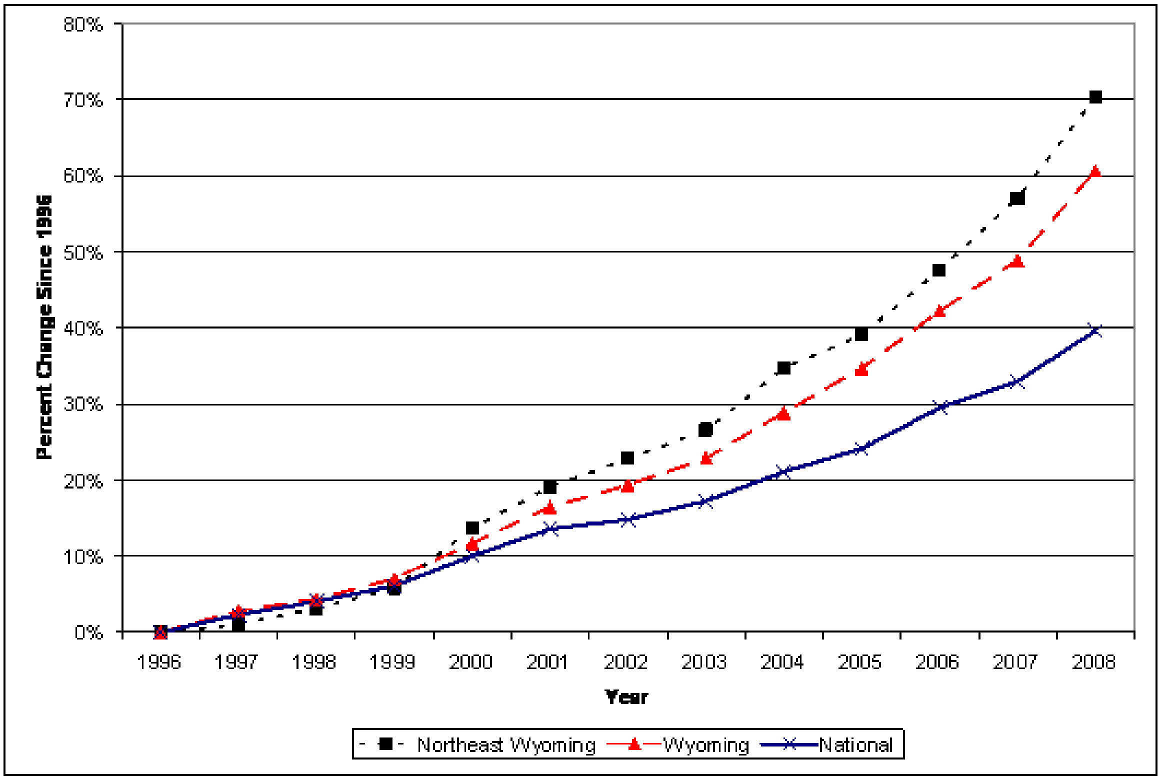
Area	2008 (annual average)	2009 (annual average)	2010| (annual average)	2011 (annual average)
Campbell County	2.0	5.42.1	6.02.0	4.6
Johnson County	3.32	7.53.4	8.23.7	7.16.3
Sheridan County	3.13.2	6.82.9	7.73.0	6.95.3
Wyoming	3.13.3	6.32.9	7.03.1	6.04.7
United States	5.84.6	9.34.6	9.65.8	8.98.6
Sources: Bureau of Labor Statistics 2012a; Bureau of Labor Statistics 2012b				

Cost of Living

One factor that affects economic and social trends in communities is the cost of living. The Wyoming Economic Analysis Division calculates relative changes in cost of living over time by estimating the cost of a set of goods and services that represents the average consumer’s purchases for housing, food, health care, travel costs, and other items. If the cost of living for a particular area increases faster than average income, that could mean that longtime residents, especially those on fixed incomes, could find their lifestyles less affordable over time. Over the long term, a higher cost of living could encourage people to move out of a community and discourage people from moving into the community in conjunction with employment opportunities.

Overall migration into the area will likely decrease, and the demographic and socioeconomic characteristics of those who move in will be determined partially by the cost of living in the area.

The Wyoming Economic Analysis Division (2012a) calculates the change in the cost of living over time for a five-county region in northeast Wyoming, consisting of Campbell, Crook, Johnson, Sheridan, and Weston counties. Figure 3.22, "Cost-of-Living Trends in Northeast Wyoming, the State of Wyoming, and the United States" (p. 475) shows how the cost of living in northeast Wyoming has changed in relation to the cost of living in Wyoming generally and in the United States. Starting in about 2000, the cost of living in the northeast region and Wyoming as a whole began to increase at a greater rate than the cost of living in the United States. The cost of living in the northeast region has risen slightly faster than the cost of living in the state as a whole, but only slightly.



Source: Wyoming Economic Analysis Division 2012a

Figure 3.22. Cost-of-Living Trends in Northeast Wyoming, the State of Wyoming, and the United States

Housing

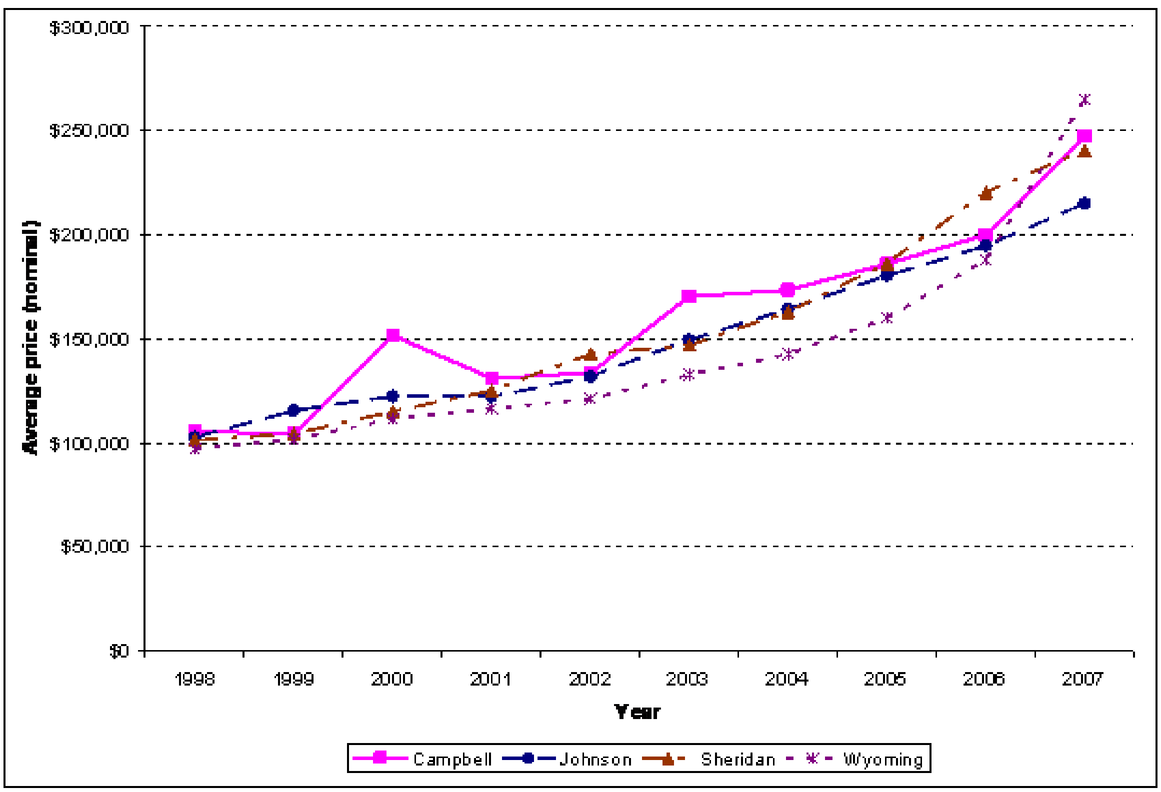
Table 3.65, "Average Housing Price, 1998-2011" (p. 476) lists average housing prices for the planning area counties from 1998 to 2011 based on sales of existing, detached single family homes on 10 acres or less sold during the previous calendar year (WHDP 2009; WHDP 2012). Figure 3.23, "Average Housing Price, 1998 through 2011" (p. 476) shows the same information graphically. The table and figure show that housing prices in the planning area counties have increased or decreased generally at the same rate, and at approximately the same rate as statewide. From about 2004 through 2007, housing prices increased at a faster rate than from 1998 through 2003, but then declined slightly with the recent economic downturn.

Table 3.65. Average Housing Price, 1998-2011

Year	Campbell County	Johnson County	Sheridan County	Wyoming
1998 ($)	105,356	102,678	101,160	96,906
1999 ($)	104,221	115,531	104,167	101,517
2000 ($)	151,615	122,354	115,003	111,437
2001 ($)	130,981	122,192	125,000	116,469
2002 ($)	133,582	131,782	142,565	121,140
2003 ($)	170,218	149,472	146,776	132,708
2004 ($)	173,420	164,125	162,917	142,501
2005 ($)	185,874	180,209	186,095	178,183
2006 ($)	199,945	194,500	220,225	219,438
2007 ($)	247,150	214,710	240,779	265,044
2008 ($)	242,341	220,549	240,270	256,045
2009 ($)	249,507	215,744	233,281	241,622
2010 ($)	238,208	204,277	242,635	250,958
2011 ($)	233,900	182,250	227,833	241,301
Number of sales in 2011	223	2	229	4,238

Sources: WHDP 2009; WHDP 2012

Note: Prices are the average for all existing detached single family homes on 10 acres or less sold during the previous calendar year, and are not adjusted for inflation.



Sources: WHDP 2009; WHDP 2012

Figure 3.23. Average Housing Price, 1998 through 2011

Table 3.66, “Rental Housing Availability (Percent)” (p. 477) lists information about rental housing availability (i.e., rental vacancy rates) since 2001. Vacancy rates in Campbell County were generally quite low from 2001 through 2007, while vacancy rates in Sheridan and Johnson counties were somewhat variable. In 2007, vacancy rates were low – less than two percent for all three counties – but in 2008 they increased, particularly in Campbell County, and remained relatively high since then.

Table 3.66. Rental Housing Availability (Percent)

Year	Campbell County		Johnson County		Sheridan County	
	June/July	November/ December	June/July	November/ December	June/July	November/ December
2001	0.7	0.7	2.4	n/a	1.0	2.8
2002	1.2	3.7	n/a	9.1	2.8	4.5
2003	1.7	1.3	3.3	2.3	4.2	3.3
2004	2.5	2.8	2.5	2.1	3.3	4.5
2005	1.1	0.6	5.4	6.1	3.0	2.3
2006	0.2	0.4	n/a	2.8	1.3	0.5
2007	0.9	0.3	1.7	1.5	0.3	1.2
2008	7.2	6.8	4.8	3.9	3.2	2.5
2009	5.7	10.5	4.9	8.1	3.4	4.3
2010	8.6	8.0	5.1	6.0	5.1	4.3
2011	8.0	7.2	7.4	9.6	4.3	4.0
2012	5.5	n/a	7.4	n/a	8.1	n/a

Source: WHDP 2012

Note: Availability is measured in percentage terms (percent of units that are vacant) based on a survey of rental agencies.

n/a not available

Table 3.67, “Poor-Rich Ratio, Employment Specialization, and Residential Adjustment” (p. 478) lists information about some additional economic variables of interest. The ratio of relatively low-income households to relatively high-income households, which provides an indication of the proportion of low-income households relative to high-income households, is lower in Campbell County and higher in Johnson and Sheridan counties, compared to the same statistic for the United States. The index of employment specialization is highest in Campbell County, reflecting primarily the relative concentration in the mining industry that was also seen in the earnings and employment statistics above. The index of employment specialization is higher in all three counties than the median for United States counties, which indicates that employment in all three of counties is relatively concentrated in a small number of industry sectors. This lack of diversification can mean that boom and bust cycles that affect particular industries can have a particularly acute impact in the planning area. Finally, the net residential adjustment shows the degree to which commuting across county borders affects earnings by place of work. Johnson and Sheridan counties had a positive residential adjustment in 2011, indicating that more earnings are received by people commuting out of these counties to work (the counties are “bedroom communities”). Campbell County had a relative large negative residential adjustment, indicating that considerable income is received by people commuting into the county to work (accounting for approximately 9.5% of the total personal income in the county).

Table 3.67. Poor-Rich Ratio, Employment Specialization, and Residential Adjustment

Area	Poor-Rich Ratio (2010)[1]	Net Residential Adjustment (%) (2011)[3]
Campbell County	3.7	-9.5
Johnson County	7.2	3.7
Sheridan County	10.1	4.0
United States [4]	5.6	n/a

Sources: U.S. Census Bureau 2010c; Headwaters Economics 2007a; Headwaters Economics 2007b; Headwaters Economics 2007c; Bureau of Economic Analysis 2012a

[1]Measures the ratio of households with income less than $25,000 to those with income exceeding $200,000 (in the 2006–2010 period). For example, a ratio of 10 indicates there are 10 households with income less than $25,000 for every household with income more than $200,000.
[2]A relative measure of the diversity of the employment base of a county compared to the employment base of the United States as a whole. A lower index indicates a more diverse employment base; a higher index indicates greater specialization (employment is more concentrated in a few economic sectors).
[3]A positive residential adjustment indicates that more earnings are received by people who commute out of the county to work; a negative adjustment indicates that more earnings are received by people who commute into the county to work. The numeric value is the net proportion of total personal income earned across county lines.
[4]In the case of the Employment Specialization Index, represents the median for all counties in the United States (not the median value for the United States as a whole).

Tax Revenues

Economic activities on BLM-administered land and mineral estate contribute to the fiscal wellbeing of local, state, and federal governments. BLM management actions have the potential to affect tax revenues from mining and mineral production; travel, tourism, and recreation; and livestock grazing and ranching.

Mineral Severance Taxes

The mining industry contributes substantially to state and local tax revenues. For example, the Wyoming State Auditor (2012) reported that state mineral severance taxes and federal mineral royalties returned to the state represented 31% of total state revenues in Fiscal Year 2012 – a total of $877 million. Table 3.68, “Estimated State Severance Tax Collections in the Planning Area Counties for Production Year 2010” (p. 478) lists estimated state severance tax collections for the planning area counties and Wyoming for production year 2010.

Property Tax and Sales Tax Base (Tax Revenues)

Another way to look at the contributions of different industries in the planning area is to consider how different economic sectors contribute to local and state property values for the purpose of property tax levies, and to local and state sales taxes. Table 3.69, “Local and State Assessed Property Valuation, 2011” (p. 479) lists local and state assessed property valuation in 2011 for the planning area counties and Wyoming. Table 3.70, “State and Local Sales Tax Collections by Sector, 2011” (p. 479) lists local and state sales tax revenues by sector for each of the counties.

Table 3.68. Estimated State Severance Tax Collections in the Planning Area Counties for Production Year 2010

Mineral	Campbell County ($)	Johnson County ($)	Sheridan County ($)	Wyoming ($)
Crude and stripper oil	27,767,573	2,966,956	73,447	177,566,278
Natural gas	25,896,502	61,404,202	10,295,824	456,086,175

Mineral	Campbell County ($)	Johnson County ($)	Sheridan County ($)	Wyoming ($)
Coal	246,955,633	0	0	284,711,737
Uranium	0	0	0	1,306,595
Sand and gravel	100,051	31,461	23,430	457,265
Bentonite	0	73,471	0	1,283,195
Trona	0	0	0	15,039,983
Decorative stone	0	201	0	4,722
Additional minerals	0	0	0	285,781
Totals	**300,695,342**	**64,454,768**	**10,378,539**	**936,690,809**
Source: Wyoming Department of Revenue 2011				

Table 3.69. Local and State Assessed Property Valuation, 2011

Area	Total ($ millions)	Agricultural (%)	Residential (%)	Commercial (%)	Mineral (%)	Industrial (%)
Local Assessed Valuation						
Campbell County	773	1	30	10	56	3
Johnson County	200	7	34	7	50	1
Sheridan County	357	4	70	15	10	1
Wyoming	7,545	3	56	15	23	3
State Assessed Valuation						
Campbell County	4,653	0	0	0	96	4
Johnson County	1,091	0	0	0	100	0
Sheridan County	189	0	0	0	92	8
Wyoming	16,795	0	0	0	92	8
Total (State and Local) Assessed Valuation						
Campbell County	5,426	0	4	1	90	4
Johnson County	1,291	1	5	1	92	1
Sheridan County	547	2	46	10	38	3
Wyoming	24,340	1	17	5	71	6
Source: Wyoming Department of Revenue 2011						

Table 3.70. State and Local Sales Tax Collections by Sector, 2011

Sector	Campbell County	Johnson County	Sheridan County	Wyoming
Agriculture, forestry, fishing, and hunting (%)	0.02	0.01	0.02	0.04
Mining (%)	28	23	8	5
Utilities (%)	6	12	5	4
Construction (%)	2	7	1	2
Manufacturing (%)	4	2	2	3
Wholesale trade (%)	15	7	4	9
Retail trade (%)	24	25	46	33
Transportation and warehousing (%)	0.04	0.1	0.04	0.2

Sector	Campbell County	Johnson County	Sheridan County	Wyoming
Information (%)	1	2	4	3
Financial activities (%)	5	8	3	5
Professional and business services (%)	0.5	1	1	1
Educational and health services (%)	0.004	0.01	0.1	0.1
Leisure and hospitality (%)	4	8	13	10
Other services (%)	8	2	4	5
Public administration (%)	3	5	11	6
Total ($ millions)	**141**	**14**	**39**	**748**
Source: Wyoming Economic Analysis Division 2012b				

Together, the data on sales tax collections and property tax assessed valuations by sector provide insight into the economic base of the counties. The fiscal stability of local and state government depends on the viability and stability of local industries. Consistent with other data in this section, the mining sector is fundamental for property tax revenue, especially in Campbell and Johnson counties. In Sheridan County, mining-related property provides an important portion of locally assessed valuation, but in a lower proportion than average for the state. Residential property also provides important contributions to local assessed valuation. Agricultural, commercial, and industrial property contribute smaller amounts to local and state assessed valuation.

Mining and retail trade are the most important contributors to sales tax collections in the planning area counties. The wholesale trade sector in Campbell County, utilities in Johnson County, and the leisure and hospitality sector in Sheridan County also contribute with important shares of sales taxes. Separate data on sales tax revenues from retail trade, accommodation, and food sales (Table 3.71, "Retail, Accommodation, and Food Sales: State and Local Sales Tax Collections, 2011" (p. 480)) provide some additional insight into the contribution from elements that could be related to travel and tourism specifically – eating and drinking places and lodging. (A sizable portion of tax collections from eating and drinking places also accrue from local residents, and a portion of gasoline station tax collections would also accrue from tourists and business travelers.) These data suggest that travel and tourism is an important contributor to sales tax collections in the planning area counties, but do not dominate collections or make an overwhelming contribution.

Table 3.71. Retail, Accommodation, and Food Sales: State and Local Sales Tax Collections, 2011

Subsector	Campbell County	Johnson County	Sheridan County	Wyoming
Auto dealers and parts (%)	19	6	7	8
Building material and garden supplies (%)	20	21	16	15
Clothing and shoe stores (%)	2	0.4	2	3
Department stores (%)	2	0.3	3	3
Eating and drinking places (%)	10	13	16	15
Electronic and appliance stores (%)	4	3	5	4

Subsector	Campbell County	Johnson County	Sheridan County	Wyoming
Gasoline stations (%)	7	9	5	7
General merchandise stores (%)	14	8	21	13
Grocery and food stores (%)	2	5	2	4
Home furniture and furnishings (%)	1	1	3	2
Liquor stores (%)	1	3	2	2
Lodging services (%)	3	9	5	8
Miscellaneous retail (%)	16	22	12	15
Total ($ millions)	**$39**	**$4.4**	**$17**	**$321**
Source: Wyoming Economic Analysis Division 2012b				

The Wyoming Office of Travel and Tourism, estimated that in 2011 travel and tourism from business and recreational visitors accounted for $68.4 million in state sales, use, and lodging tax revenues and $42.0 million in local sales, use, and lodging tax revenues, not including property tax collections related to recreation infrastructure (Dean Runyan Associates 2006). This estimate is based on the data above, and additional survey data from a variety of sources. Table 3.72, "Local and State Tax Receipts Due to Travel and Tourism in Wyoming, 2011 ($ millions)" (p. 481) shows tax receipts for the counties in the planning area.

Table 3.72. Local and State Tax Receipts Due to Travel and Tourism in Wyoming, 2011 ($ millions)

Locality	Local Tax Receipts	State Tax Receipts
Campbell County	1.8	2.6
Johnson County	0.8	1.2
Sheridan County	2.2	2.0
State of Wyoming	52.0	68.4
Source: Dean Runyan Associates 2006		

3.8.3. Health and Safety

3.8.3.1. Regional Context

The BLM Hazard Management and Resource Restoration Program addresses a variety of hazards on public surface to reduce risks to visitors and employees. Hazards can include hazardous materials; abandoned mine shafts and adits; abandoned equipment and structures; explosives and munitions; toxic gases; and spills from pipelines, tankers, and storage tanks.

Activities directed toward health and safety concerns in the planning area primarily encompass the following:

- AMLs
- Oil and gas facilities
- Hazardous wastes and materials
- Physical hazards

3.8.3.2. Indicators

Management indicators include: abandoned mine lands, coal seam fires, hazardous materials and waste, and physical hazards.

3.8.3.3. Current Condition

Abandoned Mine Lands

At present, there are there are 10 known AML sites in the planning area. These sites include sand, gravel, bentonite, and other mineral mining sites. New AML sites typically are found every year; therefore, current database records might not include every AML site in the planning area (BLM 2009h).

Physical hazards are common at abandoned mine sites and these hazards are not always apparent to visitors. Abandoned mine sites have proven to be a luring and sometimes life-threatening attraction for both children and adults. Serious injury or death can occur at these sites. Common hazards include open vertical shafts; unstable overhead rock and decayed support structures; deadly gases and lack of oxygen; remnant explosives and toxic chemicals; high walls, open pits, and open drill holes; and becoming lost and disoriented while underground. Subsidence at abandoned coal mines and coal seam fires pose additional hazards. The BLM Wyoming State Office has a prioritized list of AML sites that pose the greatest risk to people and the environment.

AML sites that impact water quality are addressed using the watershed approach. Using this approach accomplishes the following objectives:

- Allows mitigation to be risk based by identifying priority sites
- Fosters collaborative efforts across federal, state, and private administrative boundaries
- Considers all issues important to water resource protection
- Reduces the cost of mitigation
- Provides the most efficient method of remediating AML sites by utilizing a wide range of available resources

The BLM and the Wyoming DEQ, AML Division, have a cooperative agreement that facilitates the reclamation of AML sites on BLM-administered lands. The state program, as required by the Surface Mining Control and Reclamation Act of 1977, focuses on public safety hazards. In addition, the BLM has received some funding for its Soil, Water, and Air Program to address environmental hazards and watershed concerns associated with abandoned mines on a site-specific basis. By combining available funding, safety hazards and environmental impacts to water quality and watershed function can continue to be addressed in a more comprehensive fashion at priority AML sites. In this collaborative partnership approach, the BLM and the Wyoming DEQ, AML Division, are undertaking several AML reclamation projects on public lands in the planning area.

Coal Seam Fires

The burning of coal seams is not an uncommon occurrence and can be started either naturally or by human activity. With the right conditions, spontaneous combustion can occur, particularly when oxygen is present. Coal seams can also ignite from lightning strikes, wildfires, or other ignition sources.

In the western United States, research has shown that numerous coal seam fires have occurred over the last several million years. The most extensive burning of coal seams has taken place in the Powder River Basin in northeastern Wyoming and southeastern Montana (Heidel 2007). There are 43 known active and historic coal seam fires in the planning area, with the majority of these occurring on privately-owned lands (BLM 2011g).

Threats to public health and safety include gas emissions and physical hazards. Emissions from coal seam fires can include carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide, and trace elements such as arsenic, mercury, and selenium (Finkelman 2004). In limited testing in the Powder River Basin, elevated levels of carbon monoxide and methane have been detected (Coates and Heffern 1999). As a coal seam burns, the space that the coal took up is now partially empty. The rocks and soils over them are left without proper support, and they can subside, creating fissures that can reach the surface. These fissures can be several to tens of feet deep, creating a direct hazard to humans and wildlife.

Hazardous Materials and Waste

Hazardous materials in the planning area are associated with activities performed by industry and the public, and by illegal dumping of commercial or household waste. There are no approved hazardous waste dumps or repositories in the planning area. Table 3.73, "Activities and Associated Hazardous Materials" (p. 483) lists and describes potential sources of hazardous materials.

Table 3.73. Activities and Associated Hazardous Materials

Activity	Associated Hazardous Material
Hazardous materials associated with historic and ongoing mine operations	• Acid rock drainage • Chemicals associated with processing ore or used in laboratories • Explosives • Heavy metals • Asbestos
Illegal dumping	• Unauthorized landfills • Dumping of barrels or other containers with hazardous substances
Illegal activities	• Drug laboratory waste • Wire burns • Abandoned property
Hazardous material spills	• Spills from vehicle accidents • Industrial accidents
Oil and gas activities	• Hydrogen sulfide gas • Petroleum and chemical spills • Pipeline releases • Leaking tanks • Asbestos • Industrial accidents
Source: BLM 2009e	

Physical Hazards

In addition to hazardous materials, there is a variety of other hazards that could pose a risk to the public and the environment. These could include physical hazards such as abandoned structures or equipment, mine shafts, explosives and munitions, and solid waste dumps. Environmental hazards include petroleum or other chemical releases from pipelines, commercial vehicles, and storage facilities that are not regulated as hazardous materials.

Program Objectives

To protect human health and the environment and comply with applicable laws and regulations, the BLM Hazard Management and Resource Restoration Program has the following objectives:

1. Identify and control imminent hazards or threats to human health and the environment from hazardous substance releases on public lands.
2. Promote working partnerships with states, counties, communities, other federal agencies, and the private sector to prevent pollution and minimize hazardous waste on public lands.
3. Provide hazardous materials management training to BLM employees and educate public land users concerning laws, rules, and standards.
4. Require potentially responsible parties to undertake response actions and to pay their fair share or face cost recovery.
5. Encourage public collaboration in environmental decision making.
6. Inventory, assess, and manage the cleanup of hazardous substance release sites on public lands that present a potential risk to human health and the environment and promote healthy ecosystems.
7. Ensure that solid and hazardous waste treatment, storage, and disposal facilities that might affect public lands are properly located, designed, and constructed, consistent with the law.
8. Reduce hazardous waste produced by BLM activities and from authorized uses of public lands through waste minimization programs that include recycling, reuse, substitution, and other innovative, safe, and cost-effective methods to prevent pollution.
9. Ensure that authorized activities on public lands comply with applicable federal, state, and local laws, regulations, policies, guidance, and procedures.
10. Ensure appropriate review of authorized activities and application of effective management controls to correct weaknesses.

Management Challenges

Continued oil and gas development, particularly the transition from coalbed gas development to more conventional natural gas development, has the potential to increase hazardous materials spills from well drilling and development; pipelines; compressor stations; service vehicles and trucks; and other associated activities. Like many industries, oil and gas operators use specific chemicals in their drilling, recovery, and manufacturing processes. Unfortunately, “green” alternative products are not available for all chemicals used for drilling and development of oil and natural gas wells. Therefore, the focus is for the operators to minimize potential environmental impacts by properly storing, transporting, using, and disposing of hazardous materials.

With the increase in population related to energy development, increased recreational use of public land can lead to additional opportunities for illegal dumping of solid and hazardous wastes.

3.8.3.4. Trends

As the demand for oil, gas, and minerals increase, so does the potential for hazardous materials spills. Although industrial operations are regulated to minimize any potential spills, accidents can never be completely eliminated. Increased recreational activities on BLM-administered lands will put visitors at a greater risk of encountering a variety of hazards, such as chemical and physical hazards left over from past industrial operations; illegal waste dumping; and illegal drug manufacturing wastes. Although the workload could increase, the Hazard Management and Resource Restoration Program will continue to manage and respond to foreseeable hazards on BLM-administered lands the same as it does now. The program will continue to emphasize protection of public health, safety, and the environment; waste minimization; and compliance with all laws, policies, and regulations.

3.8.3.5. Key Features

There are no key features for the health and safety program.

3.8.4. Environmental Justice

Minority Populations

BLM IM 2002-164, *Guidance to Address Environmental Justice in Land Use Plans and Related NEPA Documents*, provides policy and guidance for addressing environmental justice in BLM land use planning (BLM 2002b). IM 2002-164 defines minority persons as "Black/African American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, Aleut, and other non-white persons." In addition, IM 2002-164 states that an area should be considered to contain a minority population where either the minority population of the affected area exceeds 50%, or the percentage of minority population in the affected area is meaningfully greater than the percentage in the general population.

Populations of the three counties in the planning area are predominantly white and non-Hispanic. Although minority populations have increased slightly from 2000 to 2011, all counties have a larger proportion of non-Hispanic white residents than do the state or the country. Table 3.74, "Minority and Low-Income Populations in Planning Area Counties, Wyoming, and the United States in 2000 and 2011" (p. 485) lists the percent of minority population and population in poverty in the counties in the planning area in 2000 and 2010.

Table 3.75, "Minority and Low-Income Populations in Planning Area Towns, Wyoming, and the United States in 2000 and 2011" (p. 486) lists population by race, ethnicity, and percent in poverty by town in the planning area in 2000 and 2011. The town of Clearmont has the highest percent minority among the towns listed in Table 3.75, "Minority and Low-Income Populations in Planning Area Towns, Wyoming, and the United States in 2000 and 2011" (p. 486), approximately twice the percent minority in the State of Wyoming.

Table 3.76, "Racial and Ethnic Groups in Buffalo Planning Area Counties and Wyoming, 2011" (p. 486) lists population by race and ethnicity in the planning area. The largest ethnic or racial group other than non-Hispanic whites in any of the counties is Hispanic or Latino (of any race); however, in all three counties the percent of people in this ethnic group is lower than that for Wyoming as a whole. Most ethnic and racial groups comprise a very small portion of populations in the planning area counties.

Table 3.74. Minority and Low-Income Populations in Planning Area Counties, Wyoming, and the United States in 2000 and 2011

County	Percent Minority Population in 2000	Percent Minority Population in 2011	Percent in Poverty in 2000	Percent in Poverty in 2011
Campbell	6	11	8	6
Johnson	4	6	10	7
Sheridan	5	7	11	8
Wyoming	11	14	11	10

County	Percent Minority Population in 2000	Percent Minority Population in 2011	Percent in Poverty in 2000	Percent in Poverty in 2011
United States	31	36	12	14
Sources: U.S. Census Bureau 2000; U.S. Census Bureau 2011a				

Table 3.75. Minority and Low-Income Populations in Planning Area Towns, Wyoming, and the United States in 2000 and 2011

Town	Percent Minority Population in 2000	Percent Minority Population in 2011	Percent in Poverty in 2000	Percent in Poverty in 2011
Arvada	15	3	12	0
Big Horn	2	0	1	6
Buffalo	5	29	10	6
Clearmont	6	29	20	4
Dayton	6	2	7	2
Gillette	7	12	8	7
Kaycee	2	3	15	0
Parkman	5	0	9	6
Ranchester	12	3	17	2
Sheridan	6	8	11	11
Story	2	0	15	12
Wright	4	8	6	5
Wyoming	11	14	11	10
United States	31	36	12	14
Sources: U.S. Census Bureau 2000; U.S. Census Bureau 2011a				

Table 3.76. Racial and Ethnic Groups in Buffalo Planning Area Counties and Wyoming, 2011

Race or Ethnicity (Percent of Population)	Campbell	Johnson	Sheridan	Wyoming
Non-Hispanic, White	89	94	93	86
Non-Hispanic, Black	1	0	0	1
Non-Hispanic, American Indian/ Alaska Native	1	0	1	2
Non-Hispanic, Asian, Native Hawaiian, or Other Pacific Islander	1	1	1	1
Non-Hispanic, two or more races	1	2	1	2
Hispanic or Latino (of any race)	7	3	3	8
Source: U.S. Census Bureau 2011a; percentages may not add up to 100% due to rounding				

In addition to the minority populations within the planning area, nearby reservations for Native American populations constitute an important part of the regional economy and social framework in the planning area. The Crow Indian Reservation, which is located in Bighorn, Yellowstone, and Treasure Counties in Montana, is adjacent to the northern border of the planning area, and the Northern Cheyenne Indian Reservation is 25 miles north of the northern border of the planning area. Many tribal members travel to Sheridan for shopping and to obtain services.

Low-Income Populations

BLM IM 2002-164 states that low-income populations can be identified according to poverty thresholds published by the U.S. Census Bureau. In addition, the IM notes, "when considering these definitions, it is important to recognize that some low-income and minority populations may comprise transitory users of the public lands and thus not associated with a particular geographic area."

The Council on Environmental Quality (CEQ) guidance for environmental justice analysis under NEPA defines a low-income population as "either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect (CEQ 1997)." Although CEQ guidance does not provide a quantitative threshold (e.g., a limit on the percent of persons in poverty) for determining whether a population should be considered low income, typically the percent of persons in poverty in the planning area is compared to that in a comparison area such as the state. Quantitative criteria for what constitutes a low-income population are not specified in BLM or CEQ guidance.

As Table 3.74, "Minority and Low-Income Populations in Planning Area Counties, Wyoming, and the United States in 2000 and 2011" (p. 485) shows, the percentage of people with income below the poverty level was less than 10 for all counties in the planning area in 2011, and all three counties saw a reduction in poverty from 2000 to 2011. The percentage of people in poverty was slightly higher in Wyoming and the United States in 2011. However, the town-level data in Table 3.75, "Minority and Low-Income Populations in Planning Area Towns, Wyoming, and the United States in 2000 and 2011" (p. 486) suggest that from 2000 to 2011, most counties with larger concentrations of persons living in poverty in the planning area saw reductions in their poverty rate.

3.8.5. Tribal Treaty Rights

A treaty is a formal agreement between the U.S. Government and a Native American Tribe or Tribes that cedes land or reserves rights to the tribe(s). Executive Order 13084, *Consultation with Indian Tribal Governments* (May 14, 1998), and Executive Order 13007, *Indian Sacred Sites*, provide the framework for involving Native American Tribes in the BLM planning process. Additional guidance is provided in BLM Manual 8120, *Tribal Consultation*.

BLM land use plans must address the protection of any treaty rights within the planning area. The Wind River Reservation is the only reservation in Wyoming and is over 50 miles from the planning area. There are several reservations in states bordering Wyoming with tribes that historically had treaty rights in the Powder River Basin. Tribes may retain certain rights that were not specifically ceded when treaties were abrogated.