CHAPTER 3

AFFECTED ENVIRONMENT

3.0 INTRODUCTION

The Affected Environment chapter of this environmental assessment (EA) for the proposed Little Monument Natural Gas project discusses environmental, social, and economic factors as they currently exist within the project area. The material presented here has been guided by management issues identified by the Bureau of Land Management (BLM), Rock Springs Field Office and public scoping.

This proposal could potentially affect critical elements of the human environment as listed in BLM's National Environmental Policy Act (NEPA) Handbook H-1790-1 (USDI-BLM 1988) and more recent Executive Orders. The critical elements of the human environment, their status in the LMPA and their potential to be affected by the proposed project are listed in Table 3-1. In addition to the critical elements, potential effects of the proposed project to other elements considered in this EA, are listed in Table 3-2.

Table 3-1. Critical Elements of the Human Environment[1], Little Monument Natural Gas Project Sweetwater County, Wyoming.

Element	Status on the Project Area	Addressed in text of EA
Air quality issues	Potentially affected	Yes
Areas of critical environmental concern	None present	No
Cultural resources	Potentially affected	Yes
Environmental justice	Not affected	No
Prime or unique farmlands	None present	No
Floodplains	None present	No
Native American religious concerns	Potentially affected	Yes
Invasive plants	Potentially affected	Yes
Threatened and endangered species	Potentially affected	Yes
Hazardous or solid wastes	Potentially affected	Yes
Water quality (surface and ground water)	Potentially affected	Yes
Wetlands/riparian zones	Potentially affected	Yes
Wild and scenic rivers	None present	No
Wilderness	None present	No

[1] As listed in BLM *National Environmental Policy Act Handbook H-1790-1* (USDI-BLM 1988) and subsequent Executive Orders

Table 3-2. Other Elements for Analysis, Little Monument Project Area

Element	Status on the Project Area	Addressed in text of EA
Geology/Minerals/Paleontology/Hazards	Potentially affected	Yes
Soils	Potentially affected	Yes
Vegetation	Potentially affected	Yes
Wildlife	Potentially affected	Yes
Special Status Species	Potentially affected	Yes
Noise	Potentially affected	Yes
Visual Resources/Recreation	Potentially affected	Yes
Socioeconomic Issues	Potentially affected	Yes
Range/Other Land Uses	Potentially affected	Yes

3.1 GEOLOGY/MINERALS/PALEONTOLOGY

3.1.1 Geology

3.1.1.1 Regional Geologic Overview

The LMPA lies in the west-central part of the Bridger Basin, the western topographic and structural extension of the greater Green River Basin. The greater Green River Basin is a large structural and topographic basin that occupies most of southwestern Wyoming. Both the Bridger and Green River basins are part of the Wyoming Basin Physiographic Province, which is characterized by large intermontane structural basins bounded by mountain uplifts that have Precambrian granitic rocks at their cores. The basins are filled by deposits of latest Cretaceous and Tertiary age sediments that exceed thousands of feet in thickness in the subsurface.

General structural elements that border the Bridger Basin include the Rock Springs Uplift to the east, the Wind River Range to the north, the Uinta Range to the south, and the Wyoming Thrust Belt to the west. A buried structural arch, the Moxa Arch, occurs at depth west of the area. The arch has a north-trending axis that is situated along the western side of the basin, immediately east of the leading edge of the Thrust Belt. Cretaceous formations produce oil and natural gas at depths ranging from 9,000 to 11,000 feet below grade along the arch.

The precursor to the modern greater Green River Basin developed during the late Cretaceous Period (about 75 million years ago) and began filling with sediments eroded from surrounding uplifts to the north, east and south. The Utah-Wyoming Thrust Belt began forming west of the area in early Cretaceous time with the development of large scale eastward movement of thick piles of sedimentary rocks along relatively low angle thrust faults in western Utah. Uplift and thrusting progressed eastward throughout the Cretaceous so that by the end of that period and during the succeeding early Paleocene, thrusting and associated uplift had progressed into southwestern Wyoming.

Sediment accumulated in the Bridger (and Green River Basin) in a variety of environments related to their distance from the bordering mountain fronts. Near the mountains, landslides, mudslides, and alluvial fans accumulated coarse-grained sediments. Progressively basinward from the mountains, streams, rivers, and ponds or lakes accumulated fine-grained sediments in a broad ancient flood plain and lake basin. During times when sediment supply was high, deposits of rivers and associated ponds accumulated in a broad flood basin that occupied most of the ancient basin. When uplift, erosion, and sediment supply diminished, but the basin floor continued to sink, a large lake system developed in the ancient basin center. This ancient lake system, the Green River Lakes, fluctuated dramatically in size, throughout its existence. When lake stands were high, lake deposits expanded to cover most of the basin and river deposits were restricted to the basin edges. When lake stands were low, river deposits expanded to cover most of the basin and lake deposits were restricted to the basin center. Thick, chemically precipitated deposits formed in and around the lake at times of lake restriction.

Periodic oscillation of the level of the ancient lakes resulted in a complex interfingering relationship between lake sediments and their laterally equivalent riverine sediments seen in the rock record. During the late middle Eocene, the last Green River Lake filled with chemically precipitated rocks and sediment and riverine deposits of a broad ancient flood basin once again spread across the basin. Large volumes of ash derived from the Absaroka area of northwestern Wyoming periodically blanketed the area and helped fill the lake basin with sediment.

Geologic mapping by the USGS and Wyoming Geological Survey document that sedimentary deposits of the Laney Member of the Green River Formation of early Tertiary age crop out in the LMPA (Love and Christiansen 1985, Brady 1965). A thin veneer of Quaternary soil, alluvium, colluvium, and aeolian (wind blown) material occurs above rocks of the Laney Member, but these deposits are too thin to be mapped.

Laney Member-Green River Formation

The Laney Member that underlies the LMPA at the surface forms the top of the Green River Formation and records in its sediments the greatest expansion of the ancient lake system (Lake Gosiute) followed by its final restriction and desiccation. At its peak the lake in which the Laney accumulated occupied more than 75% of the greater Green River Basin, or an area of about 15,000 square miles.

Of the three rocks units (LaClede Bed, Sand Butte Bed, and Hart Cabin Bed) comprising the Laney Member distinguished by Roehler (1993), only the LaClede Bed crops out in the LMPA. The LaClede Bed regionally consists chiefly of oil shale with lesser amount of limestone, sandstone, claystone and tuff. Thick deposits of oil shales characteristic of the LaClede Bed that occur in the more central areas of the greater Green River Basin accumulated in the deeper parts of the Lake Gosiute, during the longest high stand of the lake, which may have lasted as long as 2.5 million years. The LMPA would have occupied an area nearer the lake edge and was a site dominated by sandstone, shale, and marlstone.

Older-Underlying Sedimentary Rock Units

Underlying the Green River Formation in the LMPA are Phanerozoic sedimentary rocks, which range from Cretaceous to Cambrian in age. Some of these rocks produce oil and gas. The Phanerozoic sediments are underlain by Precambrian metamorphic bedrock that comprises part of the ancient North American cratonic shield.

Geological Hazards

Naturally occurring geologic hazards include fault generated earthquakes, floods, landslides or other mass movements. There are no known faults with surface expression or earthquake epicenters mapped within the LMPA (NEIC 2003, WGS 2003). The nearest mapped earthquake epicenter occurs in the northeastern part of the LaBarge Oil and Gas Field, approximately 15 miles to the northwest, where a quake of 2.9 on the Richter scale occurred at a depth of 5 km in 1993.

There are no landslide deposits mapped in the area and no major areas of surface mass movement were observed during a field survey. Topographic relief is approximately 355 feet (6,775 ft to 7,130 ft) and slope over most of the area is gentle. Slopes are steepest eastward into an unnamed tributary of Fourmile Gulch (Sec. 26, T25N, R111W), where over a lateral distance of about 2,000 ft elevation rises about 170 ft yielding a grade of about 8.5%. Geologic dip on the Laney Member of the Green River Formation exposed at the surface is nearly horizontal and overlying soils are well drained, thus lessening the chance for naturally occurring mass movements.

3.1.2 Mineral Resources

Major mineral resources within the LMPA are oil and gas. Trona and oil shale deposits that characterize parts of the Green River Formation occur to the south and east of the LMPA in areas that were in the most central parts of ancient Green River Lakes System.

Oil and gas production was first discovered in the LMPA in 1979 in Burlington Resources' Little Monument Unit 23-14, drilled in Section 14, T25N, R111W. Production is from the first and second benches of the Cretaceous age Frontier Formation at depths of about 9,250 ft and 9,350 ft respectively. To date, the LMPA has produced approximately 26,709 Bbls oil and 21,332,152 Mcf gas. The unit currently contains 31 producing natural gas wells, 2 plugged and abandoned wellbores, and 1 temporarily abandoned wellbore.

3.1.3 Paleontology

Paleontologic resources within sedimentary deposits of the Laney Member of the Green River Formation (including the LaClede Bed), in Wyoming record the history of animal and plant life in Wyoming during the early part of the Cenozoic Era (middle Eocene Epochs). Fossils of gastropods, bivalves, and fish are common in the shales and some limestones of the LaClede Bed. Impressions of plants and insects have also been reported from shales. A single fossil mammal has been recovered from a black, fossil gastropod-bearing chert in the Washakie Basin (Roehler 1992). Locality searches of the University of Wyoming (Laramie), University of Colorado (Boulder), and University of California (Berkeley) museum fossil collections did not reveal any existing localities within the area and the only fossils observed during spot field survey of the LMPA were sparse fossil wood.

Paleontology Ranking

The BLM considers the Green River Formation to be a Class 5 paleo formation meaning they are highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils and/or scientifically significant nonvertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts. However, not all areas of Class 5 paleo formations are

highly fossiliferous.

3.2 CLIMATE AND AIR QUALITY

3.2.1 Climate

The project area is located in a continental dry, cold-temperate-boreal climate (Trewartha 1968), which has limited rainfall and long, cold winters. Meteorological measurements collected at La Barge, Wyoming (1958-2001), approximately 13 miles northwest of the project area, indicate that the annual average total precipitation for the area is 8.3 inches, ranging from 3.4 inches (1975) to 17.8 inches (1995). Precipitation is greatest from late spring to early fall, with the peak monthly average of 1.35 inches occurring in May. An average of 30.9 inches of snow falls during the year (an annual high 43.6 inches in 1987), with heaviest monthly snowfalls occurring in December and January. Table 3-3 shows the mean monthly temperature ranges and average precipitation amounts.

Temperatures are generally cooler, frost-free periods shorter, and both precipitation and snowfall greater at higher elevations. The region is typically cool, with average daily temperatures (in degrees Fahrenheit; °F) ranging between –1 °F (low) and 32 °F (high) in mid winter and between 42 °F (low) and 79 °F (high) in mid summer. Extreme temperatures have ranged from –52 °F (occurring in 1990) to 95 °F (occurring in 1973). The frost-free period (above 32 °F) generally occurs from early June to mid-September.

The project area is subject to strong and gusty winds, reflecting channeling and mountain valley flows due to complex terrain. During the winter months, strong winds are often accompanied by snow, producing blizzard conditions and drifting snow. The closest comprehensive wind measurements are collected by Amoco Corporation in the Jonah Field, approximately 27 miles north and east of LMPA. Figure 3-1 shows the relative frequency of winds, with radial distributions by speed class, indicating the direction of the wind source. From this information, it is evident that the winds originate from the northwest nearly 40 percent of the time. The annual mean wind speed is nearly 12 mph.

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

Tables 3-4 and 3-5 show the frequency distribution of wind speed and atmospheric stability class in the Jonah Field. The atmospheric stability class is the measure of atmospheric turbulence, which directly affects pollutant dispersion. The stability classes are divided into six categories designated “A” (unstable) through “F” (stable). The “D” (neutral) stability class occurs more than half of the time. Stability classes A through C are generally associated with good dispersion, stability class D with fair dispersion, and stability classes E and F with poor dispersion.

Table 3-3. La Barge, Wyoming, 1958-Present Mean Monthly Temperature Ranges and Average Precipitation Amounts

Month	Average Temperature Range (^{O}F)	Average Precipitation (inches)	Average Snowfall (inches)
January	-2 - 31	0.3	6.2
February	1 - 35	0.4	4.4
March	14 - 43	0.4	4.0
April	23 - 54	0.8	2.8
May	32 - 65	1.4	1.3
June	39 - 73	1.1	0.0
July	44 - 83	0.7	0.0
August	42 - 82	0.9	0.0
September	33 - 71	0.8	0.1
October	22 - 59	0.6	1.7
November	11 - 42	0.5	4.3
December	-1 - 31	0.5	6.0
ANNUAL	38.6 (mean)	8.3 (mean)	30.9 (mean)

Source: (WRCC 2001)

Table 3-4. Wind Speed Distribution.

Wind Speed (miles/hour)	Percent of Occurrence
0-4.0	7.4
4.0-7.5	26.3
7.5--12.1	29.3
12.1-19.0	23.9
19.0-24.7	7.5
Greater than 24.7	5.5

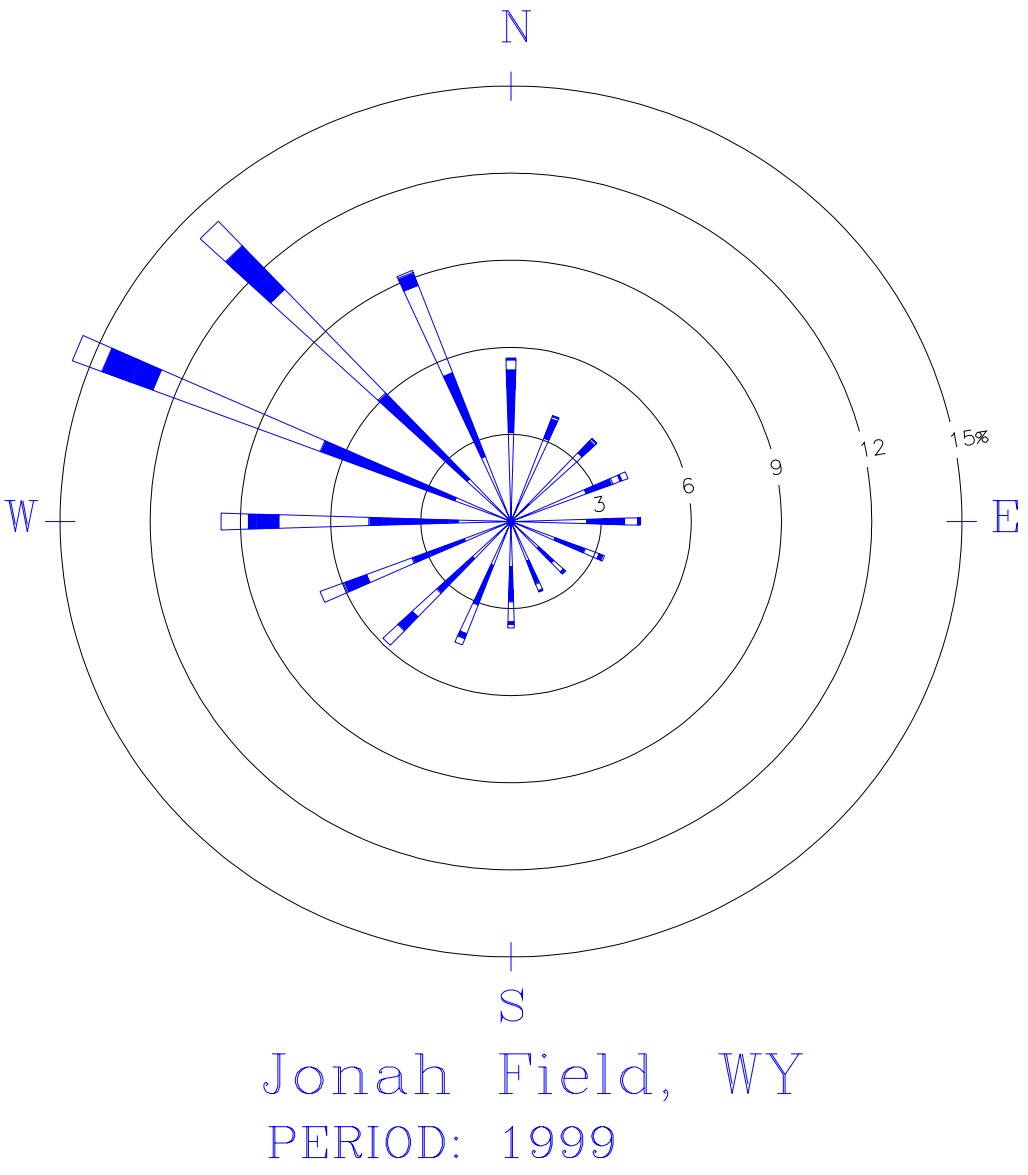


Figure 3-1. Wind Rose for the Little Monument Project Area.

Table 3-5. Stability Class Distribution.

Stability Class	Percent of Occurrence
A	2.6
B	6.4
C	11.2
D	59.0
E	17.4
F	3.3

3.2.2 Air Quality

The Wyoming and National Ambient Air Quality Standards set absolute upper limits for specific air pollutant concentrations at all locations where the public has access. Also, the Prevention of Significant Deterioration (PSD) Program is designed to limit the incremental increase of specific air pollutant concentrations above a legally defined baseline level. Incremental increases in PSD Class I areas are strictly limited, while increases allowed in Class II areas are less strict. The project area and surrounding areas are classified as PSD Class II. The two closest PSD Class I areas, the Bridger and Fitzpatrick Wilderness Areas, lie over 45 miles to the northeast of the project area and could be impacted by cumulative project source emissions.

All NEPA analysis comparisons to PSD Class I and II increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD Increment consumption analysis. The determination of PSD increment consumption is an air quality regulatory agency responsibility. Such an analysis would be conducted as part of the New Source Review process for a major source, as would an evaluation of potential impacts to Air Quality Related Values (AQRV) such as visibility, aquatic ecosystems, flora, fauna, etc performed under the direction of Federal Land Managers, or would be conducted to determine minor source increment consumption.

Although specific air quality monitoring has not been conducted within the project area, air quality conditions are likely to be very good, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches) and good atmospheric dispersion conditions. These factors contribute to relatively low ambient air pollutant concentrations, supported by the finding that background values measured in the region are well below established standards. Measured air pollutants include: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, particulate matter less than 10 microns in effective diameter (PM-10), and sulfur dioxide (SO_2). Measured regional background air pollutant concentrations, applicable Wyoming and National Ambient Air Quality Standards, and PSD Class I and II increments (measured in micrograms per cubic meter, or :g/m^3) are provided in Table 3-6.

All background concentration data have been identified by WDEQ-AQD as the most representative air quality monitoring data available for the region. An estimate of background air quality concentrations is needed not only to determine existing air quality conditions but to combine with modeled project-related air quality impacts for comparison to applicable air quality

standards. It is important that each pollutant's background concentration, model predictions, and air quality standards are based on the same averaging times.

Continuous visibility-related optical background data have been collected at the PSD Class I Bridger Wilderness Area in Wyoming, as part of the Interagency Monitoring of PROtected Visual Environments (IMPROVE) program. Visibility in the Central Rocky Mountains is very good (averaging over 70 miles Standard Visual Range), with fine particle impacts accounting for nearly half of the average degradation (Sisler 1996). In addition, a background atmospheric deposition (acid rain) monitoring system is in place at the National Acid Deposition Program/National Trends Network sampling station near Pinedale, Wyoming, and site-specific lake chemistry (pH, acid neutralizing capacity, elemental concentrations, etc.) monitoring is conducted by the U.S. Geological Survey Water Quality Division in several high mountain lakes in regional wilderness areas. Total nitrogen and sulfur deposition near Pinedale has been below Forest Service guidelines since 1990 (see Figures 3-2 and 3-3).

The WDEQ-AQD, under their EPA approved State Implementation Plan, is the primary air quality regulatory agency responsible for determining potential impacts once detailed industrial development plans have been made, and those development plans are subject to applicable air quality laws, regulations, standards, control measures, and management practices. Therefore, WDEQ-AQD has the ultimate responsibility for reviewing and permitting the project prior to its operation. Unlike the conceptual "reasonable, but conservative" engineering designs used in NEPA analyses, any WDEQ-AQD air quality preconstruction permitting demonstrations required would be based on very site-specific, detailed engineering values, which would be assessed in the permit application review.

3.3 SOILS

The topography of the Little Monument project area consists of bedrock knobs, rolling uplands underlain by shales, sandy shales, and sandstones of the middle Eocene Green River Formation (LaClede Bed). No major drainages head in the project area and as a result these rocks are relatively uneroded. Shales underlying the surface are deeply weathered and, together with a significant amount of aeolian (wind-blown) sand, the weathered rock detritus serves as the parent material for the development of an Upland Slope Soil that is distributed throughout the LMPA. This soil is shallow (less than 60 cm total thickness), occurs on slopes of 0-10%, and consists of loamy sand and sandy clay loam. The following site specific soil description is characteristic of the Upland Slope Soils in the area:

Site LMSO1

UTM 12: 579607E, 4664818N. Surface of soil littered with weathered 5-20 mm chips of weathered shale and sandstone.

A = Non-calcareous loamy sand; 2 cm.

Bt = Weakly calcareous sandy clay loam; unconsolidated; pH = 7.1; 10YR4/4 (dark yellowish-brown); 23 cm.

Table 3-6. Air Pollutant Background Concentrations, State and Federal Ambient Air Quality Standards, and PSD Increments (:g/m^3).

Pollutant/Averaging Time	Measured Background Concentration	State and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline PSD Class I	Incremental Increase Above Legal Baseline PSD Class II
Carbon Monoxide (CO)				
1-hour	3,336 [a]	40,000	n/a	n/a
8-hour	1,381 [a]	10,000	n/a	n/a
Nitrogen Dioxide (NO_2)				
Annual	3.4 [b]	100	2.5	25
Ozone				
1-hour	169 [c]	235	n/a	n/a
8-hour	147 [c]	157		
Particulate Matter (PM_{10})				
24-hour	47 [d]	150	8	30
Annual	16 [d]	50	4	17
Sulfur Dioxide (SO_2)				
3-hour (National)	132 [e]	1,300	25	512
24-hour (National)	43 [e]	365	5	91
24-hour (Wyoming)	43 [e]	260	n/a	n/a
Annual (National)	9 [e]	80	2	20
Annual (Wyoming)	9 [e]	60	n/a	n/a

Notes: n/a - not applicable
Wyoming Ambient Standards from: Wyoming Air Quality Standards and Regulations, Chapter 2– Ambient Standards
National Ambient Standards from: 40 CFR Part 50
PSD Increments from: 40 CFR Part 52 Subpart A 52.21 Prevention of Significant Deterioration of Air Quality.

Background Air Quality Data Sources:

a Data collected by Amoco at Ryckman Creek for an 8-month period during 1978-1979, summarized in the Riley Ridge EIS (BLM, 1983).

b Data collected at Green River Basin Visibility Study site, Green River, Wyoming during period January-December, 2001 (ARS, 2002).

c Data collected at Green River Basin Visibility Study site, Green River, Wyoming during period June 10, 1998 through December 31, 2001 (ARS, 2002).

d Data collected by WDEQ at Emerson Building, Cheyenne, Wyoming, 2002.

e Data collected at LaBarge Study Area at the Northwest Pipeline Craven Creek site (1982-1983).

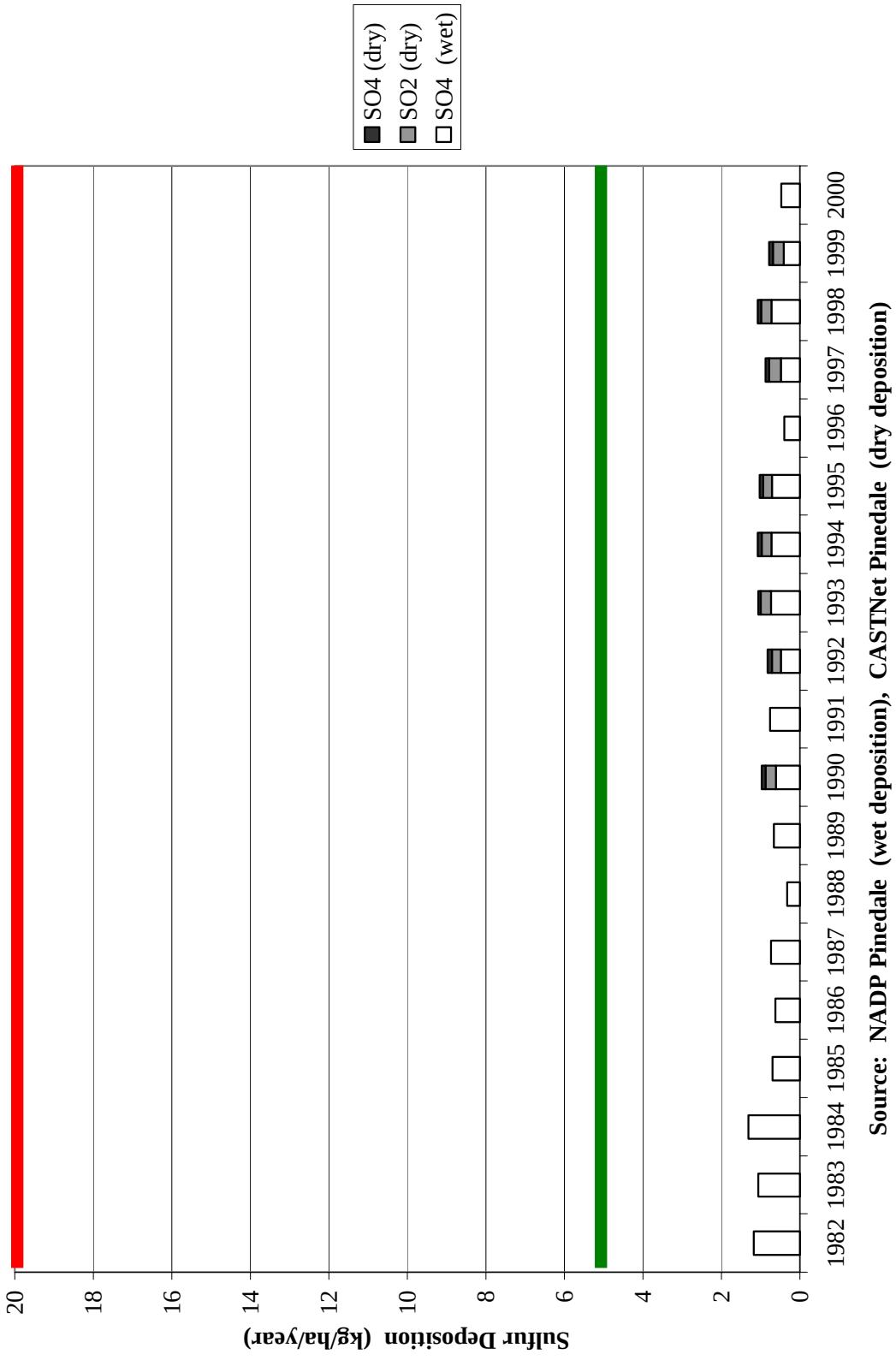


Figure 3-2. Total Sulfur Deposition near Pinedale, Wyoming.

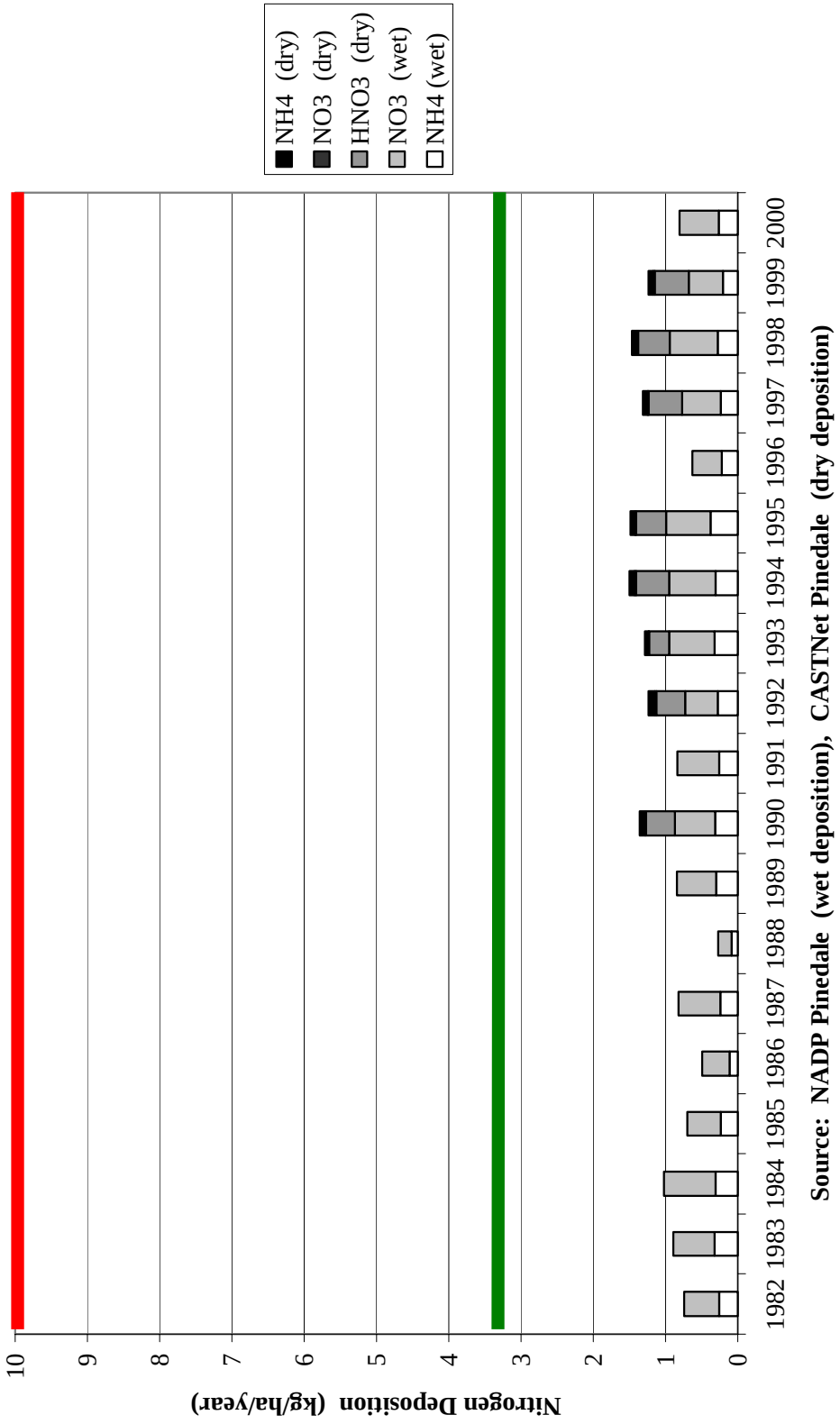


Figure 3-3. Total Nitrogen Deposition near Pinedale, Wyoming.

Btk = Highly calcareous sandy clay loam with 2-5 mm CaCO3 pisoliths (stage 1 calcrete); 10YR6/3 (pale brown); 27 cm.

Ck = Weathered shale of Green River Formation.

Due to its high sand content in the Upland Slope Soil, the area is well-drained, very permeable, and exhibits little evidence of surface runoff. Erosion potential is thereby low, but would be increased by blading on slopes or removal of plant cover.

3.4 WATER RESOURCES

Water resources in the project area include both streamflow and groundwater. Surface water resources include several ephemeral (flow only in response to rainfall or snowmelt) streams within the Green River drainage basin. The headwaters of tributaries to the Green River that originate within the project area include Fourmile Gulch, an unnamed tributary of Fourmile Gulch, and the West Fork of Buckhorn Canyon. Fourmile Gulch and its tributaries drain the majority of the project area. West Fork drains the extreme northeastern corner of the project area and flows into Buckhorn Canyon. Both Buckhorn Canyon and Fourmile Gulch are major tributaries of Eighteenmile Canyon. The ephemeral Eighteenmile Canyon is an important surface water resource in the general vicinity, but is more than 10 miles to the east and south of the project area. Eighteenmile Canyon discharges into the Green River approximately 25 miles downstream of the Fontenelle Reservoir. No surface runoff from the project area drains directly into the Green River. The Green River and Fontenelle Reservoir are important surface water resources in the general vicinity, but the project area is located approximately 3.5 miles north of the reservoir at its closest point. No springs are located within or near the project area. Groundwater resources include free water contained within relatively shallow aquifers that are or could be used for domestic, agricultural, and/or industrial purposes. The occurrence and distribution of water resources in the project area are dependent on climate, soils, and structural geology (Geology Section 3.1).

3.4.1 Precipitation

Climatic conditions are greatly affected by the large changes in altitude that occur within Sweetwater County. Precipitation ranges from roughly eight inches per year in the southeastern part of the county to an estimated 16 inches per year in the southern most part of the county. The annual precipitation recorded at different locations but of similar elevations within Sweetwater County is fairly consistent. Most of the county receives less than 10 inches of precipitation, and is classified as desert (Martner 1986).

The mean annual precipitation recorded at the Fontenelle Dam station for the period of record is 7.35 inches. Precipitation is somewhat evenly distributed throughout the year with a peak in May. The majority of precipitation falls as rain from frontal systems and thunderstorms. In regard to intensity of rainfall events, the 50-year, 24-hour precipitation rate is 2.0 inches (Miller et al. 1973). Average total snowfall depth for the year at Fontenelle Dam is approximately 23 inches, with the greatest snowfall occurring in December and February (WRCC 2003). Due to the effect of ablation and snow drifting, a discontinuous snow cover is usually present during the winter.

3.4.2 Surface Water

3.4.2.1 Surface Water Quantity

Surface water occurs relatively infrequently within the project area, which is situated at the headwaters of Fourmile Gulch, an unnamed tributary of Fourmile Gulch, and a very small portion of West Fork. Ground surface elevations range from over 7,200 feet to 6,900 feet above sea level. As shown on Figure 3-4, the project area is drained almost entirely by tributaries of Fourmile Gulch. West Fork, an ephemeral tributary of Buckhorn Canyon, drains the extreme northeastern corner of the project area. Fourmile Gulch and Buckhorn Canyon are both ephemeral tributaries of Eighteenmile Canyon Creek, itself an ephemeral stream. There are no naturally occurring lakes, ponds, or springs in the project area.

The project area falls entirely within the Green River drainage basin. Fourmile Gulch (a 76 square-mile watershed) flows generally southward to intersect Eighteenmile Canyon. West Fork (a 51 square-mile watershed) is a tributary of Buckhorn Canyon. Buckhorn Canyon (a 143 square-mile watershed) also flows generally southward into Eighteenmile Canyon (a 465 square-mile watershed), which is a tributary of the Green River. The Green River drains to the Colorado River, which ultimately drains into the Pacific Ocean. The Green River is the only perennial stream in the general vicinity of the project area. South of the project area the Green River exits Fontenelle Reservoir, the largest body of water in the general area with a design capacity of 34,000 acre-feet. The reservoir has domestic, industrial, recreation, hydroelectric, and irrigation uses. The Green River and its tributaries above Fontenelle Reservoir originate mostly in mountainous areas, where significant annual precipitation occurs and where geologic conditions induce groundwater discharge.

No streamflow-gaging or sampling stations have been established by the United States Geological Survey (USGS) within or near the project area. Therefore, no streamflow or surface water quality records currently exist to support a site-specific description of the surface water resources. USGS Station 0921120 (Green River Below Fontenelle Reservoir, Wyoming) is the closest continuous streamflow gaging site to the project area. This station measures streamflow from a 4,280 square-mile drainage area and has been operated continuously since 1964. The mean annual streamflow over the period of record at this station is 1,734 cubic feet per second (cfs). The highest mean annual flow occurred in 1986 when discharge reached 3,093 cfs. The lowest mean annual discharge from the reservoir was 582 cfs in 1977. The highest instantaneous peak flow from Fontenelle Reservoir was 14,100 cfs measured on July 3, 1982. The USGS maintained a crest-stage gage at Station 09211300, Fourmile Gulch Trib. Near Fontenelle, Wyoming, from 1979 through 1981. This site is located on the western unnamed tributary of Fourmile Gulch, and is located about 4.5 miles downstream of the project area. The drainage area above this site is 14.2 square miles. This unnamed tributary of Fourmile Gulch drains roughly two-thirds of the project area (Figure 3-3). Instantaneous peak discharges recorded at this site were 84.0 cfs in 1979, 6.0 cfs in 1980, and 3.0 cfs in 1981 (USGS 2003).

To estimate the streamflow characteristics of streams with no streamflow-gaging stations Lowham (1988) developed equations that relate features of a drainage basin to streamflow. Lowham identified three distinct hydrologic regions (Mountainous, High Desert, and Plains) within the State of Wyoming to estimate streamflow characteristics in each region. Most of the project area is within the High Desert Region and streams that drain desert areas in Wyoming are usually ephemeral or intermittent. Typically, under this flow regime, ephemeral streamflow will last for only a short period of time after a runoff-producing event, or intermittent streamflow

is sustained for longer periods of time due to an association with groundwater (i.e., discharge from a spring).

Flow within the ephemeral stream channels correlates directly with precipitation; surface runoff occurs during spring and early summer as a result of snowmelt and rainfall (Lowham et al. 1985). Streams within the project area receive no support from groundwater discharge to sustain flow; consequently, there are extended periods of time when the drainages are dry. Active stream channels in the project area exhibit flow only during snowmelt and high-intensity, short-duration summer thunderstorms. Rainstorm runoff can cause large peak flows, although the duration of flow from rainfall is relatively short in comparison to snowmelt runoff. Because precipitation varies from year to year, runoff volumes vary as well.

The only surficial geologic unit within the project area is the Tertiary-age Laney Shale Member of the Green River Formation. The Laney Shale generally consists of an interbedded mixture of marlstones (calcareous clays), siltstones, mudstones, shales, and oil shale of lacustrine deposition (Welder and McGreevy 1966). The types of particles that comprise the sedimentary bedrock largely determine the texture of the residual soil that develops from that deposit. Therefore, most of the soils within the project area generally have a heavy clay texture with low infiltration and permeability rates. Soil and bedrock susceptibility to water erosion can be severe due to low permeability, and the area's sparse desert shrubland vegetative cover exposes more surface to raindrop impact erosion. As a result of the project area's slow infiltration rates and sparse vegetal cover, runoff potential is relatively high. The mean annual runoff from this high desert area is estimated to be between 0.5 and 2 inches, or between seven and 20 percent of the total annual precipitation (Wyoming Water Research Center 1990).

Based upon a recent (February 2003) review of the Wyoming State Engineer's Office (SEO) records, there are no active surface water rights within the project area. According to the SEO, temporary surface water rights in this area were issued in the late 1970's and early 1980's, but have since expired. These consisted of water haul truck operations from the Green River for immediate uses associated with oil and gas development (i.e., well drilling, road and facility construction).

3.4.2.2 Surface Water Quality

Surface water quality in semiarid regions is seasonal and dependent on the magnitude and frequency of discharge events, although the dissolved solids concentration typically increases in the downstream direction. During periods of little to no precipitation, evaporation and capillary action produce a salt residue on the surfaces of bedrock, soils, and channel deposits. Runoff from rainfall and snowmelt then periodically flushes the accumulated salts downstream. During high-intensity thunderstorm events, the dissolved solids concentration increases rapidly during the early period of runoff, but will then decrease after the initial flushing of salts has taken place. During less intense, low-flow events, the dissolved solids concentration generally increases in the downstream reaches. In streams where base flows are responsible for a very small part of overall streamflow, flushing of salts by floods appear to be the major mechanism by which dissolved solids are transported from the basin. The flushing action is a process that affects the quality of plains streams of southwestern Wyoming (Lowham et al. 1982). In less arid areas, less evaporation and more frequent flushing of accumulated salts would generally result in lower dissolved solids concentrations throughout the year. Due to the erosive nature of the area, relatively high-suspended sediment concentrations are also expected.

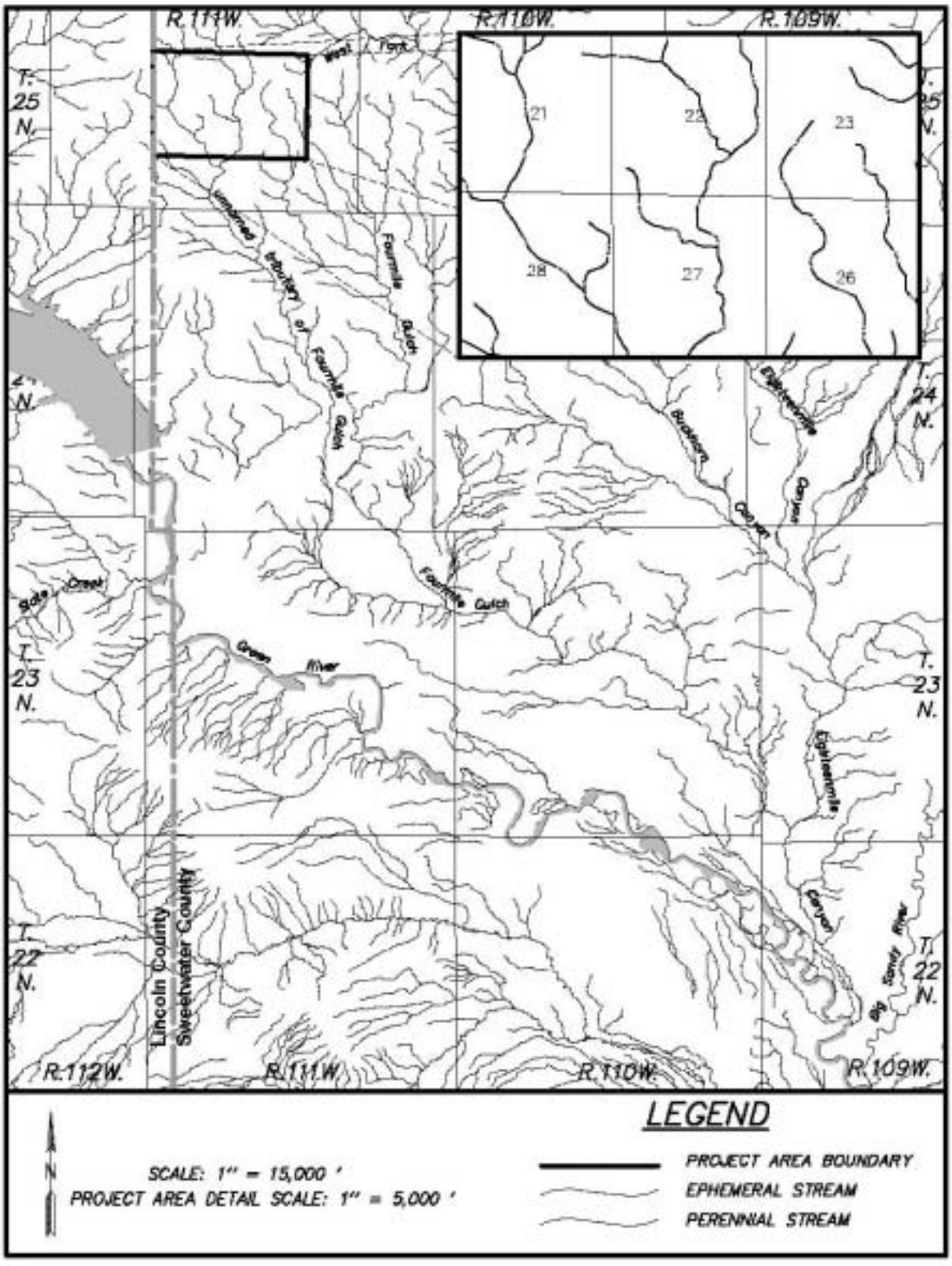


Figure 3-4. Surface Water Features in LMPA

As indicated in the previous section, there are no established USGS surface water quality sampling stations within the project area. The surface water quality in the Green River drainage basin, in general, is addressed in several reports published by the USGS (i.e., DeLong 1977, DeLong and Wells 1988, Ringen 1984). Suspended sediments, dissolved solids, and salinity are the constituents that are primarily evaluated, as they are typically indicators for the evaluation of water for various uses. These reports also relate streamflow discharge to these constituents. The USGS has collected monthly surface water quality samples from the Green River just below Fontenelle Reservoir at Station 09211200 from 1967 through the present. These samples have been analyzed for the major inorganic constituents, nutrients, and sediment concentrations during various times over the period of record. Samples currently collected are being analyzed for nutrients, pH, specific conductance, temperature, dissolved oxygen, and total dissolved solids (TDS) concentration (USGS 2003). In general, surface water quality data for the Green River just below Fontenelle Reservoir indicate that the waters are of good quality. TDS concentrations are typically between 200 to 300 mg/L, pH around 8.5, calcium and bicarbonate the dominant ions, and total suspended sediment (TSS) concentrations (analyzed from 1975 through 1978) are very low, seldom exceeding 10 mg/L.

Miscellaneous grab samples were collected by Western Wyoming College from the Green River downstream of the Eighteenmile Canyon confluence, but upstream of the Big Sandy River confluence in Section 29, T22N:R109W (Figure 3-3). These samples, collected in 1976 and 1977, had a TDS concentration of 164 and 324 mg/L, and a pH of 8.7 and 8.3, respectively. The BLM collected a miscellaneous surface water grab sample from Eighteenmile Canyon in August 1976 at a location approximately two miles upstream of the Green River confluence. The flow was reported to be just 0.3 cfs, the TDS concentration was 4,290 mg/L, with sodium (944 mg/L) and sulfate (2,330 mg/L) the dominant ions (WDRS 2003). Although no other site-specific data are available for the general area, surface water, when available, should be suitable for wildlife and livestock watering, industrial, and agricultural uses.

Point pollution sources have not been documented in the project area, and if they have occurred, they were probably accidental and of limited areal extent and of short duration. The primary non-point pollution source is natural erosion of geologic units. Grazing, oil and gas development, and poor road construction may further increase the high erosion rates described in the Soils Section.

The Wyoming Department of Environmental Quality (WDEQ) classifies Wyoming surface water resources according to quality and degree of protection (WDEQ 2001). Four classes have been identified as follows:

Class 1. Those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of significant quantities of developable water and other values of present and future benefit to the people.

Class 2. Those surface waters other than Class 1 determined to be presently supporting game fish or drinking water supplies or where these uses are attainable.

Class 3. Those surface waters, other than those classified as Class 1, that because of natural habitat conditions, do not support nor have the potential to support fish populations or spawning. Class 3 waters provide support for invertebrates, amphibians or other flora and fauna which inhabit water at some stage of their life cycles. Generally, Class 3 waters have wetland characteristics, which are a primary indicator used in identifying Class 3 waters.

Class 4. Those surface waters, other than those classified as Class 1, where it has been determined that aquatic life uses are not attainable.

Fourmile Gulch, Buckhorn Canyon, and Eighteenmile Canyon are all Class 3 surface waters. All tributaries of these streams including those within the project area, are undesignated and by default take on the classification of the stream they run into. The entire Green River below New Fork River has been designated a Class 2 surface water.

The Wyoming Game and Fish Department (WGFD) has also classified surface waters in regard to the quality of trout fishing (WGFD 1991). Fourmile Gulch, Buckhorn Canyon, and Eighteenmile Canyon are Class 5 streams (incapable of supporting fish). The Green River below Fontenelle Dam to the Flaming Gorge Reservoir is a Class 2 stream (very good trout waters).

Salinity. A primary water quality concern is increased salinity levels in area surface waters. Salinity has been noted as a key factor that limits water use and is a concern relative to downstream water uses. Salinity has become a major concern within the Colorado River drainage basin. The 1972 Clean Water Act required the establishment of numeric criteria for salinity for the Colorado River. In 1973, seven Colorado River basin states created the Colorado River Basin Salinity Control Forum. The Forum developed water quality standards for salinity including numeric criteria and a basin-wide plan of implementation. The plan consists of a number of control measures to be implemented by State and Federal agencies. In 1974, Congress enacted the Colorado River Basin Salinity Control Act. The Act was amended in 1984. The amendments required the Secretary of Interior to develop a comprehensive program to minimize contributions from lands administered by the BLM.

Moderately erosive and saline soils naturally occur within and around the project area. Saline soils are associated with parent material from sedimentary rocks of the Tertiary Green River Formation. Once the soil is disturbed (i.e., from construction of a road or well pad), the potential for the release of residual soil sediment is increased. It is possible that oil and gas activities in the general area have and will continue to contribute to both sedimentation and salinity levels presently being experienced in the Green River. All of the soils within the project area have the potential of creating water quality-related sediment and salinity problems when disturbed.

The project area is situated at the headwaters of Eighteenmile Canyon and is approximately 28 miles from the watershed's confluence with the Green River. As shown in Figure 3-3, no surface runoff from the project area drains directly into the Green River. In addition, the project area covers only six square miles, or roughly 1.5 percent, of the entire Eighteenmile Canyon watershed area. Water quality deteriorates within ephemeral streams with increasing watershed area due to increased salinity contributions from the flushing of salts from normally dry surfaces. Intense storms can cause saline runoff, but since streams in the area are ephemeral, this source has only a temporary effect on water quality.

3.4.2.3 Waters of the U.S.

Most of the surface water features in the project area qualify as Waters of the United States. Waters of the U.S. include the territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams), special aquatic sites, and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). The EPA and COE regulate such areas. Any activity that involves discharge of dredge or fill material into or excavation of such areas is subject to regulation by the COE pursuant to Section 404 of the CWA. Activities that modify the morphology of stream channels are also subject to regulation by the Wyoming SEO. Special aquatic sites and wetlands are discussed in greater detail in the Vegetation Wetlands and Noxious Weeds Section (Section 3.5).

3.4.3 Groundwater

Groundwater resources include deep and shallow, confined and unconfined aquifers. The project area occurs in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); and the Upper Colorado River Basin groundwater region described by Freethey (1987). Lowham et al. (1985) discusses regional aquifer systems within the Green River basin. Evaluations of hydrogeology specific to the Green River basin and the Overthrust Belt of southwestern Wyoming are discussed by Welder (1968) and Ahern et al. (1981). In addition, an investigation of groundwater resources within Lincoln County, Wyoming by Eddy-Miller et al. (1996) is applicable to the project area. No groundwater data that are site-specific to the project area are currently available, although some miscellaneous information from water wells located within the Eighteenmile Canyon watershed (WRDS 2003) was used in the following discussion.

3.4.3.1 Location and Quantity

Several rock units can be classified as water-bearing zones (aquifers) within the Green River structural basin of southwestern Wyoming. As described in Table 3-7, these aquifers vary in thickness, potential well yields, and water quality. Not all of the geologic formations listed in Table 3-7 are encountered within the project area (Geology Section 3.1). The only geologic unit that outcrops within the project area is the Laney Shale Member of the Green River Formation. The Wasatch Formation, which underlies the Green River Formation, is the most extensive water-bearing formation in the Green River basin. However, the Wasatch Formation is deeply buried directly beneath the general project area. Rocks of Tertiary age are widely distributed in the Green River basin, and most wells and springs produce and issue from the Green River and Wasatch Formations and their members (Eddy-Miller et al. 1996). The Green River and Wasatch Formations generally contain groundwater under artesian conditions (Welder 1968). The Wasatch Formation is the source of water for a number of named and unnamed springs in the vicinity of the project area.

Welder (1968) stated that recharge to groundwater reservoirs in the Green River basin is principally from the infiltration of precipitation (direct rainfall, overland flow, and snow melt). However, most of the precipitation leaves the area as surface runoff before it can infiltrate. Groundwater is discharged mainly by the intersection of the water table with the land surface,

evapotranspiration, inflow to streams and lakes, and discharge from pumping wells. Evaporation in this arid area removes more water from the basin than any other means of discharge. Discharge via water wells and transpiration by plants is not significant (Welder and McGreevy 1966). Springs and seeps occur where the local water table intersects the land surface, or where fractures and faults that act as groundwater conduits intersect the land surface. Groundwater movement within the Green River basin is basically toward the center of the basin.

According to Lowham et al. (1985), wells completed in the Green River Formation within the Green River basin yield up to 300 gpm, with a median yield of 10 gpm. Pumped discharge from wells completed in the Wasatch Formation within the basin ranges from 0.5 to 688 gpm, with a median discharge of 22.2 gpm. Flowing wells yield 0.2 to 550 gpm, with a median flow of 15 gpm (Lowham et al. 1985). Most water wells are completed in sandstone aquifers at depths of less than 500 feet. The uses for the water include stock, domestic, monitoring, and miscellaneous uses. The static water level in the wells varies greatly, but is generally less than 200 feet below ground level.

A recent (February 2003) SEO records review revealed that there is currently one active groundwater permit in the project area. The facility (Little Colorado Well #5) is located at the NW¼SE¼ of Section 22, T.25N., and R.111W. This 760-feet deep well is used for livestock watering, the static water level is 155 feet below ground surface, and according to the SEO records, it yields 18 gpm.

3.4.3.2 Quality

Groundwater quality is largely related to the depth of the respective source aquifer and the rock type. The quality of water in the various geologic formations underlying the Green River basin ranges from very poor to excellent (Welder 1968). In general, groundwater in the basin becomes more mineralized and therefore more saline and of higher TDS concentration with increased depth.

Large dissolved solids concentrations are present in most wells and springs; however, wells and springs nearer the mountain recharge areas generally have better quality water. Water from less than 50 percent of the wells and springs in the Green River basin have TDS concentrations within the 500 mg/L maximum concentration recommended by the National Secondary Drinking Water Regulation (Lowham et al. 1985). The secondary regulations are not mandatory and are often exceeded. The dissolved solids criterion for livestock is much less stringent than for domestic uses and concentrations of less than 5,000 mg/L generally are suitable for livestock.

Again, there are no site-specific data available for the project area, although the USGS (Eddy-Miller et al. 1996) compiled a large database of samples collected from aquifers within Lincoln and Sweetwater Counties. TDS concentrations of groundwater samples from the Wasatch Formation within Lincoln County ranged from approximately 200 mg/L to 5,400 mg/L. Those samples that were collected from springs near the recharge area were of a calcium carbonate type with a TDS less than 300 mg/L, whereas those samples collected farther away from the recharge area were of a sodium sulfate type with a TDS concentration over 1,000 mg/L. As reported by Eddy-Miller et al. (1996), the TDS concentrations of groundwater samples from members of the Tertiary Green River Formation in Lincoln County ranged from approximately 200 mg/L to 4,500 mg/L. Samples from the Laney Shale Member exhibited a mean TDS

Table 3-7.Hydrostratigraphy of Geologic Units in the Green River Basin and Overthrust Belt of Southwest Wyoming[1]

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
Cenozoic	Quaternary	Alluvium	<100 thick in Green River basin; up to 410 feet thick in Bear River Valley of Overthrust Belt.	• Highly permeable, productive water-bearing deposits. • Well yields commonly 50 to 500 gpm. • Transmissivity generally 5,000 to 30,000 gpd/ft. • Total dissolved solids are generally less than 500 mg/L.
	Tertiary	Miocene and Pliocene sediments including Bishop Conglomerate, Browns Park, South Pass, Camp Davis, Salt Lake, and Teewinot Formations.	0-6,000	• Poorly consolidated conglomerates are well drained. • Yields generally range from 10 to 120 gpm. • Maximum reported spring discharge from Salt Lake Formation is 8,000 gpm. • Three transmissivity calculations range from 1,000 to >100,000 gpd/ft. • Total dissolved solids generally less than 500 mg/L.
		Fowkes Formation	0-2,600	• Locally yields water to wells and springs in Overthrust belt. • One Fowkes spring discharges 125 gpm.
		Bridger Formation	0-2,300	• A major aquifer in eastern Green River basin - Overthrust belt. • Yields from wells and springs commonly range from 2 to 100 gpm. • Transmissivities are commonly between 500 and 3,000 gpd/ft.
		Green River Formation (including Laney, Wilkins Peak, Angelo and Fossil Butte Members)	100-2,800	• A major aquifer in eastern Green River basin. • Sandstone lenses in Laney Shale generally yield 3 to 100 gpm to wells and springs. • Transmissivities range from 1,000 to 6,500 gpd/ft. • Vertical permeability is very low due to great thickness of tight marlstone and shale above and below sands. • Total dissolved solids concentrations in Laney Shale usually exceed 1,500 mg/L. • Wilkins Peak TDS levels are typically 10,000 to 100,000 mg/L.
		Wasatch Formation	2,500 to 7,200	• Major aquifer of Green River basin. • Well yields range from 1 to 1,300 gpm, though commonly less than 50 gpm. • Transmissivity generally ranges from 200 to 1,000 gpd/ft. • Oil field pay zone porosity and permeability range from 20 to 25 percent and 0.02 to 18 gpd/ft^2, respectively. • Total dissolved solids concentrations between 300 and 1,000 mg/L may be expected.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
Cenozoic	Tertiary	Fort Union Formation	0-6,000	• Locally utilized aquifer of Green River basin and southern Overthrust belt. • Oil and gas field data indicate pay zone porosities of 9 to 23 percent and sandstone permeability of <.01 to 0.5 gpd/ft^2.
Cenozoic-Mesozoic	Tertiary- Upper Cretaceous	Evanston Formation	1,350-2,900	• Conglomerates and conglomeratic sandstones present in the Overthrust belt are capable of yielding moderate to large quantities of water to wells. • Yields to two Evanston wells are 3 and 200 gpm. • An estimated 1,000 gpm flows from one Evanston spring.
Mesozoic	Upper Cretaceous	Adaville Formation	1,400-5,000	• Generally considered a minor aquifer of the Overthrust belt area, though no well data or spring yield records exist for the unit.
		Blind Bull Formation	<9,200	• Small quantities of water are available from sandstone layers.
		Hilliard Shale Baxter Shale	3,000- 6,800?	• Major regional confining unit of Green River basin and Overthrust belt area. • Locally yields small quantities to wells from sand lenses. • Oil field pay zone porosity is 10 to 21 percent.
		Frontier Formation	1,100-3,000?	• Aquifer yields 5 to 50 gpm to springs. • Porosity of oil field pay zones is 8 to 25%. • Transmissivities from drill stem tests generally less than 10 gpd/ft. • Variable cementation and lenticularity of beds causes irregular occurrence of high transmissivity zones.
		Sage Junction Formation	<3,300	• Few hydrologic data are available. • Based on lithologies, small quantities of water are probably available from sandstone layers.
	Lower Cretaceous	Aspen Shale	400-2,200	• Locally utilized aquifer, maximum spring and well yields 25 to 30 gpm. • Oil field pay zone porosity of 15 percent in “fractures”. • Water yields are mainly from stray sands and fracture zones.
		Quealy Formation	500-1,100	• Few hydrologic data are available. • Based on lithologies, water is probably not available from this unit.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
		Wyan Formation	<3,900	• Unknown
Mesozoic	Lower Cretaceous	Cokeville Formation	850-3,000	• Few hydrologic data are available. • Based on lithologies, small quantities of water are probably available from sandstone layers.
		Bear River Formation	800-1,500	• Minor aquifer with spring yields generally 4 to 15 gpm and similar well yields. • Oil field pay zone porosity is 8 to 21 percent. • Pump test transmissivities are 300, 2,300, 9,500 gpd/ft (specific capacities 0.3, 2.3, and 7.8 gpm/ft), calculated drill stem test transmissivity generally less than 45 gpd/ft. • Porosity and permeability are highest in the “Muddy” and “Dakota” members.
		Thomas Fork Formation	400-1,700	• Few hydrologic data are available. • Based on lithologies, small quantities of water are probably available from sandstone layers.
		Smiths Formation	300-850	• Few hydrologic data are available. • Based on lithologies, small quantities of water are probably available from sandstone layers.
		Gannett Group (includes Smoot Formation, Draney Limestone, Bechler Conglomerate, Peterson Limestone, Ephraim Conglomerate)	800-5,000	• Water-bearing units restricted to sandstones and conglomerate in lower part. • Transmissivity estimate of 160 gpd/ft for the Bechler Member. • Springs in Bechler conglomerate member flow 5 to 75 gpm.
	Upper Jurassic	Stump Sandstone-Preuss Redbeds	270-460	• Unit is considered a poor aquifer with one well yield of 5 gpm and spring flows of 20 and 50 gpm. • Transmissivities estimated from 3 drill stem tests are less than 12 gpd/ft.
	Middle Jurassic	Twin Creek Limestone	800-3,800	• Minor aquifer in Overthrust belt. • Spring flows range from 20 to 300 gpm. • Transmissivity estimates range from less than 1 to 16 gpd/ft. • Permeability is generally less than 0.002 gpd/ft^2 and porosity from one oil field pay zone is 1.7 percent.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
	Lower Jurassic	Nugget Sandstone	750-1,300	• Major aquifer of Mesozoic system. • Springs flow 3 to 300 gpm with four flows of 1,400 to 2,000 gpm. • Well yields not available. • Transmissivity estimates range from 9 to 37 gpd/ft in the Green River Basin and 1.9 to 186 in the Overthrust belt.
Mesozoic	Triassic	Ankareh Formation	200-800	• Minor regional aquifer, locally confining. • One spring flows 200 gpm. • No current well production. • Transmissivity from one drill stem test is 0.5 gpd/ft.
		Thaynes Limestone	1,100-2,600	• Generally considered a regional aquifer with spring flows of 5 to 1,800 gpm (4 less than 100 gpm) and one well flowing 150 gpm. • Oil field pay zone porosity at one field is less than 5 percent. • Transmissivity estimates from 3 oil field drill stem tests are 0.3 to 38 gpd/ft. • The unit is most productive where solution openings, bedding plane partings, and fractures exist.
		Woodside Formation	350-600	• Unit acts as regional aquitard. • Well and spring data not available.
		Dinwoody Formation	250-700	• Regional aquitard with local productive zones. • One spring flows 150 gpm. • Transmissivity estimate from one drill stem test is 8.8 gpd/ft.
Paleozoic	Permian	Phosphoria Formation	200-400	• Unit is minor aquifer, locally confining. • One well and one spring yield 200 and 300 gpm, respectively. • Transmissivity estimates typically less than 13 gpd/ft. • Most productive from fracture zones and interbedded sandstones in the upper part of the formation.
	Pennsylvanian	Tensleep Sandstone (includes Wells Formation)	450-1,000	• Major aquifer of Paleozoic System. • Well yields range from 210 to 700 gpm. • Spring flows are commonly less than 210 gpm. • Transmissivity estimates from 11 drill stem tests are 0.14 to 38 gpd/ft. • Good interstitial permeability and excellent secondary permeability where fractured.

ERA	PERIOD	GEOLOGIC UNIT	THICKNESS (ft)	HYDROLOGIC PROPERTIES
	Mississippian-Pennsylvanian	Amsden Formation	400-700	• Minor aquifer in Green River basin, but locally confining in Overthrust belt. • One Amsden well yields 8 gpm. • Oil field pay zone porosity at 3 fields is 7 to 12 percent. • Transmissivity estimates from 4 drill stem tests are less than 1 to 4.8 gpd/ft. Permeability is less than 0.02 gpd/ft^2.
Paleozoic	Mississippian	Madison Limestone	800-2,000	• Major regional aquifer. • Excellent solution and fracture permeability. • Maximum well yield of 720 gpm, though most yields are less than 100 gpm. • Four springs flow less than 350 gpm, two others flow 4,000 and 40,000 gpm. • Transmissivity is typically less than 15,000 gpd/ft. • Specific capacity generally 0.1 to 10 gpm/ft.
	Devonian-Mississippian	Darby Formation	400-1,000	• Major aquifer with permeability dependent upon degree of fracturing and secondary solution, best developed in Overthrust belt. • Four Darby springs flow 5 to 1,100 gpm. • One well yields more than 5 gpm.
	Ordovician	Bighorn Dolomite	400-1,000	• Highly productive aquifer where fracture, secondary solution and bedding plane permeability are well developed. • Three Bighorn springs flow 250 to 450 gpm, one flows 3,200 gpm. • Porosity from one oil field is 2 percent. • Well data are not available.
	Cambrian	Gallatin Limestone	125-1,000	• Well and spring data not available; however, lithology as well as fracture and secondary solution permeability development are indicative of a potentially productive aquifer.
		Gros Ventre Formation	500-2,500	• Unit is generally considered a regional aquitard with low vertical permeability due to upper and lower shales. • Well data are not available.
		Flathead Sandstone	175-200	• Well and spring data are not available for the unit. • Lithology is similar to basal Cambrian in other basins of western Wyoming where Flathead equivalents are highly permeable, productive aquifers.

1 - Adapted from Ahern, et al. (1981) and Eddy-Miller, et al. (1996).

concentration of 860 mg/L and were of a sodium-bicarbonate type. In addition, a search of the Wyoming Water Resources Data System (WRDS 2003) was conducted for the analyses of groundwater samples collected from any wells located near the project area. The search revealed the chemical analyses of samples collected by the USGS from seven wells completed in the Laney Shale Member. These wells are all located in the northwestern corner of Sweetwater County, but none are closer than about six miles to the project area. These samples had TDS concentrations ranging from 311 mg/L to 26,525 mg/L, and the dominant ions are sodium, bicarbonate, and sulfate. Miscellaneous samples have been collected by the USGS from three wells completed in the Wasatch Formation in the same general area and the TDS concentrations ranged from 704 mg/L to 1,053 mg/L.

Groundwater within the Green River basin occurs under both water table and confined (artesian) conditions. The unconfined aquifers are generally the unconsolidated Quaternary age alluvial deposits and some of the thicker and widespread consolidated formations of Tertiary age. Groundwater movement within these unconfined aquifers is generally downslope and follows the drainages. The Green River, Wasatch, and older formations are generally under artesian pressure and the confining beds restrict the movement of groundwater between aquifers, hence, movement of potential contaminants between aquifers. Individual aquifers within the Green River basin may differ greatly between thickness and areal extent, although they are probably interconnected enough to allow some degree of hydrologic connection (Welder 1968). Due to the numerous faults within the Overthrust Belt, groundwater movement is difficult to define (Eddy-Miller et al. 1996). Concerns have been raised for several gas field projects in southwestern Wyoming regarding groundwater quality degradation due to the piercing of confining layers and vertical and horizontal migration and mixing of water of variable qualities. Data suggesting this is a current problem in the project area are not available. Improperly completed wells could be a potential source of contamination between aquifers.

3.5 VEGETATION, WETLANDS AND NOXIOUS WEEDS

3.5.1 General Vegetation

Vegetation on the LMPA is dominated by Wyoming big sagebrush/mixed grass prairie and desert shrub communities. The project area is located within the Green River and Great Divide Basin (7" - 9") Precipitation Zone, Region 4 (USDA-SCS 1986). Accordingly, native plants in this area of southwestern Wyoming are primarily xeric-adapted, drought-tolerant low shrub, grass, and flowering forb species.

3.5.1.1 Vegetation Cover

A vegetation cover-type map of the project area (Figure 3-5) was provided by the Wyoming Geographic Information Science Center (WYGISC 2003) and used to calculate areas and boundaries of primary and secondary land cover types. Information for secondary vegetation types and plant species of concern was also provided by the Wyoming Natural Diversity Database (WYNDD 2002).

Based upon the Wyoming Gap Analysis Program (GAP, Merrill et al. 1996), Wyoming big sagebrush was classified as the primary cover type (100%) on the project area. Two secondary cover types were also classified: desert shrub populations (13.8%) on the western half of the area with the remainder of the area classified as mixed grass prairie (86.2%) (Table 3-8).

Table 3-8. Vegetation Cover Types on the Little Monument Project Area As Identified by the Wyoming GAP Analysis Program (Merrill et al. 1996).

	Primary		Secondary	
Vegetation Cover Type	Acres	Percent	Acres	Percent
Wyoming big sage	3857.0	100	-	-
Desert shrub	-	-	533.5	13.8
Mixed grass prairie	-	-	3323.5	86.2
TOTAL	3857.0	100.0	3857.0	100.0

Wyoming big sagebrush: Wyoming big sagebrush (*Artemesia tridentada* ssp.*wyomingensis*) is the dominant cover type on the project area, covering 3,857.0 acres (100%). The description of this cover type from the Wyoming GAP analysis is as follows (Merrill et al. 1996): "Total shrub cover in this type comprises more than 25% of the total vegetative cover. This type is variable in Wyoming and ranges from dense, homogeneous Wyoming big sagebrush to sparsely vegetated arid areas where Wyoming big sagebrush is the dominant shrub. Often, patches of Wyoming big sagebrush are found with patches of mixed grasses. In these cases the type is classified as Wyoming big sagebrush steppe if the sagebrush patches occupy more than 50% of the total landscape area and as mixed grass if the grasses occupy more than 50% of the total area."

Resolution of upland land surface area of the GAP layer is approximately 100 hectares (248 acres), therefore, smaller stands of some secondary cover-types such as basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*) and cushion plant communities, although present, may fail to appear on the map and their extent cannot be calculated.

Mixed grass prairie: This is a "catch-all" type for grasslands that contain a mixture of short grass and tall grass prairie species. These grasslands do not contain buffalo grass, considered an indicator of short grass prairie. Mixed grass prairie often occurs in patches intermixed with shrub species such as sagebrush. Dominant plant species in this cover type include: thickspike wheatgrass (*Agropyron dasystachyum*), western wheat grass (*Agropyron smithii*), bottlebush squirreltail (*Sitanion hystrix*), needle-and-thread (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass *(Agropyron spicatum*), and threadleaf sedge (*Carex filifolia*). Forbs and especially woody crowned half-shrubs such as Hood's phlox (*Phlox hoodii*), Hooker's sandwort (*Arenaria hookeri*), cushion wild buckwheat (*Eriogonum ovalifolium*), green rabbitbrush (*Chrysothamnus viscidiflorus*), winterfat (*Eurotia lanata*), and broom snakeweed (*Gutierrezia sarothrae*) occur in some locations as understory dominants with the sagebrush. These sites are usually alkaline with limited permeability, and often occur on thin soils with rocky or gravelly subsurface materials. Locoweed (*Oxytropis* spp.) and milkvetch (*Astragulus* spp.) are poisonous plants often occurring with this cover type (Merrill et al. 1996).

Desert shrub: This type is a "catch-all" for a mixture of shrubs usually associated with dry, saline habitats. Shrub cover is often dominated by alkaline/saline adapted species such as shadscale saltbush (*Atriplex confertifolia*), but can be a mixture of Gardner's saltbush (*Atriplex gardneri*), greasewood (*Sarcobatus vermiculatus*) and/or desert cushion plants (Merrill et al. 1996).

3.5.1.2 Biological Soil Crusts

An often overlooked, but extremely vital component of Wyoming's semiarid rangelands, especially in the Wyoming big sagebrush cover type, are the biological soil crusts that occupy most of the open space not occupied by vascular plants. Biological soil crusts predominantly are composed of cyanobacteria (formerly blue-green algae), green and brown algae, mosses, and lichens (Belnap et al. 2001). Liverworts, fungi, and bacteria can also be important components. Because they are concentrated in the top 1-4 mm of soil, they primarily affect processes that occur at the soil surface or soil-air interface and include soil stability, atmospheric N-fixation, nutrient contributions to plants, soil-plant-water relations, infiltration, seeding germination, and plant growth (Belnap et al. 2001). Crusts are well adapted to severe growing conditions, but poorly adapted to compressional disturbances such as trampling by humans and livestock, wild horses, wildlife, or vehicles driving off roads. Disruption of the crusts decreases organism diversity, soil nutrients, stability, and organic matter (USGS 2002).

3.5.2 Waters of the United States, Including Wetlands

Wetlands are unique and important due to their relative rarity in the arid West, their functional role in and as components of hydrologic systems, their unique and important wildlife habitat and forage value, their heritage value, and their protection and regulation under the CWA.

The Green River RMP (USDI-BLM 1997) defines wetlands as lands transitional between terrestrial and aquatic systems where the water 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 predominately hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. The most common wetland classification system used in Wyoming is the Cowardin System (Cowardin et al. 1979). Under this system, all wetlands in Wyoming belong to one of three different inland systems: (1) Palustrine (marsh or pond-like), (2) Lacustrine (lake-like), or (3) Riverine (river-like).

The location and classification of potential wetlands in the project area were determined from a draft USFWS National Wetlands Inventory (NWI) map (Figure 3-6) provided by the WYGISC (2003). Two man-made wetlands are located in the eastern one-half of the project area: one in Section 23, T25N:R111W and the other in Section 26, T25N:R111W. The Cowardin System classifies these locations as: (1) PUSCx (Palustrine, unconsolidated shore, seasonally flooded/excavated), and (2) PUBFx (Palustrine, unconsolidated bottom, excavated). There are no PEMC (Palustrine, emergent, seasonally flooded) wetlands in the area which are usually associated with irrigated meadows and hay fields. The linear wetlands shown in Sections 21 and 22 are classified as Riverine, intermittent streambed, temporarily flooded. All drainages in the Upper Green-Slate watershed, such as the two linear systems shown, eventually drain into the Green River (WDEQ 2001).

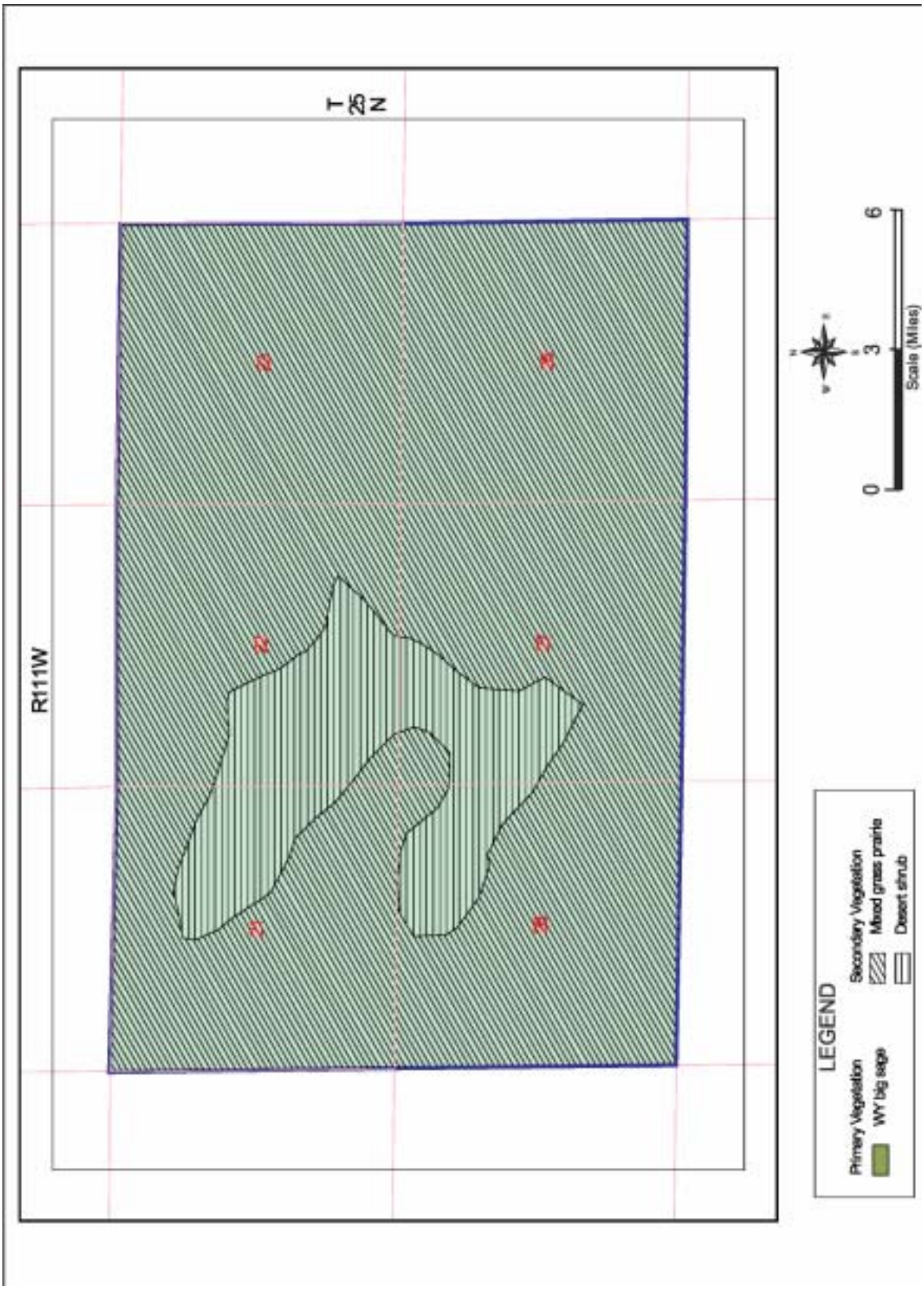


Figure 3-5. Vegetation Cover Types on the Little Monument Project Area.

3.5.3 Noxious Weeds

On 3 February 1999, Executive Order (EO) 13112 ("Invasive Species") was signed by President Clinton. The primary purpose of this EO is to prevent the introduction of invasive species and provides for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. In Wyoming, some 428 taxa have been documented as invasive (Hartman and Nelson 2000). Of these 428 taxa, 22 are designated as noxious by the State of Wyoming (Rice 2002) and are shown in Table 3-9.

Noxious weeds are very aggressive and invading infestations tend to exclude other native plant species thereby reducing the overall forage production of desirable shrubs, herbaceous grasses and forbs. The project area is vulnerable to infestations of noxious weeds, especially on newly disturbed surfaces. Current drought conditions in Wyoming (NOAA 2003) increase the probability that noxious weeds may become established in stressed or disturbed habitats.

Table 3-9. Designated Noxious Weeds in Wyoming.[1]

Scientific Name	Common Name
Agropyron repens	Quackgrass
Ambrosia tomentosa	Skeletonleaf bursage
Arctium minus	Common burdock
Cardaria draba, C. pubescens	Hoary cress, whitetop
Carduus acanthoides	Plumeless thistle
Carduus nutans	Musk thistle
Centaurea diffusa	Diffuse knapweed
Centaurea maculosa	Spotted knapweed
Centaurea repens	Russian knapweed
Chrysanthemum leucanthemum	Ox-eye daisy
Cirsium arvense	Canada thistle
Convolvulus arvensis	Field bindweed
Cynoglossum officinale	Houndstongue
Euphorbia esula	Leafy spurge
Isatis tinctoria	Dyers woad
Lepidium latifolium	Perennial pepperweed
Linaria dalmatica	Dalmatian toadflax
Linaria vulgaris	Yellow toadflax
Lythrum salicaria	Purple loosestrife
Onopordum acanthium	Scotch thistle
Sonchus arvensis	Perennial sowthistle
Tamarisk spp.	Salt cedar

[1] Designated Noxious Weeds, Wyoming Stat. § 11-5-102 (a)(xi) and Prohibited Noxious Weeds, Wyoming Stat. § 11-12-104.

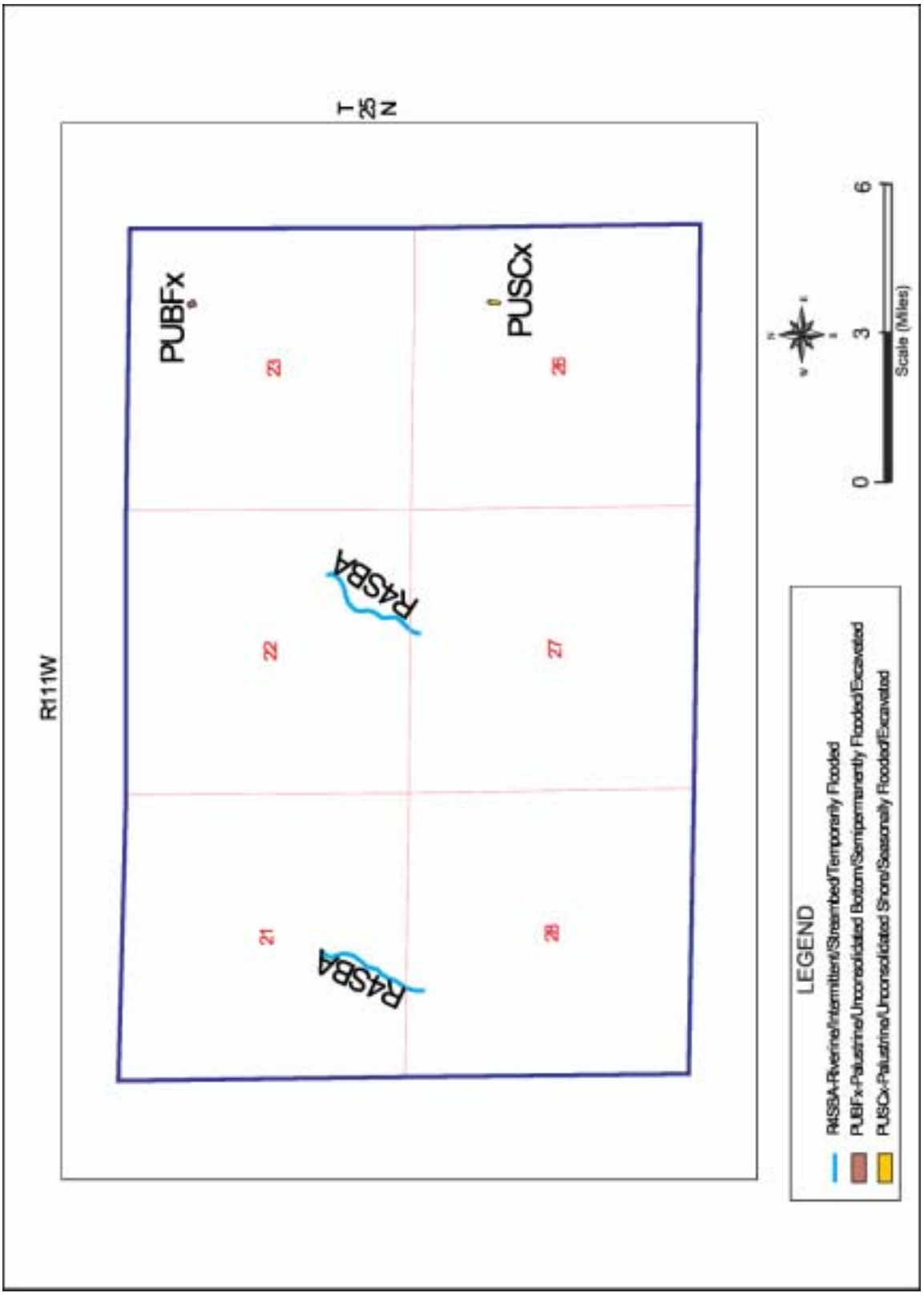


Figure 3-6. Wetland Cover Types on the LMPA.

3.6 RANGE RESOURCES

The LMPA is located within the Eighteen Mile grazing allotment (No. 13017) which encompasses a total of about 245,659 acres; of which, 228,841 acres (93%) are managed by the BLM; 14,896 acres (6%) by the Bureau of Reclamation; and 1,922 acres (1%) by the State of Wyoming. Land surface area of the LMPA represents about 1.3% of the total land area of the Eighteen Mile allotment. A total of 18,925 permitted AUM's are authorized by the BLM for the allotment. However, this total may be reduced, especially in drought years, to protect the rangeland resource (Pers. Comm. Jay D'Ewart 2003). An AUM is defined in the Green River RMP (USDI-BLM 1997) as the amount of forage required to sustain one mature cow or the equivalent based on an average daily forage consumption of 26 pounds of dry matter per day for one month (780 pounds per month). The grazing ratio on the Eighteen Mile allotment is about 13 acres per AUM. Eight livestock operators currently hold permits to run either sheep or cattle on the federal portions of the allotment (Pers. Comm. Jay D'Ewart 2003).

3.7 WILDLIFE AND WILD HORSES

3.7.1 Introduction

The LMPA lies within the BLM's Green River Resource Area administered by the RSFO. Objectives for wildlife management on the resource area are directed by the Record of Decision of the Green River RMP (USDI-BLM 1997). The RMP provides for multiple use planning and management of public lands and resources in a combination designed to meet present and future needs.

The project area is small (3,857 acres) relative to the overall size of the resource area (5.36 million acres), yet this area provides diverse habitat that supports a wide variety of resident, migrant, and seasonally resident wildlife species. Because many wildlife species are highly mobile and can readily move in and out of the project area, records of current and historical wildlife species occurrences were obtained for the project area and a six-mile zone surrounding it. Since activities within the permit area could potentially affect nesting raptors and sage grouse breeding activities that are outside the project area, the area of analysis was expanded for these species to include a two-mile buffer zone.

Information concerning current and historical wildlife locations was obtained from several sources. Information regarding sage grouse lek and raptor nest locations was obtained from the RSFO. Additional information was acquired from the Wyoming Game and Fish Department (WGFD) Wildlife Observation System (WOS). This listing contains records for all types of wildlife (birds, mammals, reptiles, amphibians). The *Atlas of Birds, Mammals, Reptiles, and Amphibians in Wyoming* (WGFD 1999) was also used to assess the potential occurrence of species in the project area. This atlas divides Wyoming into 28 degree blocks, and the presence or absence and breeding activity of vertebrate species are documented by degree block. The project area is located in degree blocks 15 and 16. A species was considered to have the potential for occurrence in the project area if it was reported as observed, breeding, or historically present within degree blocks 15 or 16. Annual big game herd unit reports from the WGFD were also used. Finally, data was acquired from Wyoming Natural Diversity Database (WYNDD). Location records for vertebrate species of special concern (federal or state) within a township buffer of the project area were obtained from WYNDD (2002). Although wild horses

are not managed as a wildlife species by the WGFD and BLM, they are included in the wildlife sections of this document.

3.7.2 Wildlife Habitat

Wildlife habitats that could be affected by the project include both the areas which would be physically disturbed by the construction of gas wells, related roads, pipelines, and production facilities, as well as zones of influence surrounding them. Zones of influence are defined as those areas surrounding, or associated with, project activities where impacts to a given species or its habitat could occur. The shape and extent of such zones varies with species and circumstance.

One primary wildlife habitat is found in the project area. This primary habitat type, Wyoming big sagebrush steppe, corresponds with the vegetation cover types described in Section 3.5 of this document.

3.7.3 General Wildlife

A total of 367 species has been recorded on or proximal to the project area either as residents or migrants and includes 78 mammal species, 277 bird species, 5 amphibian species, and 7 reptile species (Appendix A). The presence of these wildlife species was determined solely from the sources of information discussed in Section 3.7.1.

Although all species in Appendix A are important members of a functioning ecosystem and wildlife community, most are common and have wide distributions in the region. Consequently, the relationship of most of these species to the proposed project are not discussed in the same depth as species which are threatened, endangered, rare, of special concern, of special economic interest, or are otherwise of high interest or unique value.

3.7.4 Big Game

Four big game species: mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), pronghorn antelope (*Antilocapra americana*), and moose (Alces alces) occur on the project area. Big game populations are managed by the WGFD within areas designated as herd units and are discussed in that context.

The types of big game habitat designated by WGFD (1996, 2002a), and discussed in this document, include winter, yearlong, winter/yearlong, crucial winter, crucial winter/yearlong, spring/summer/fall, and out (or non-use areas). Winter ranges are used by a substantial number of animals during winter months (December through April). Winter/yearlong ranges are occupied throughout the year but during winter they are used by additional animals that migrate from other seasonal ranges. Yearlong ranges are occupied throughout the year and do not receive an influx of animals during winter. Crucial range (i.e. crucial winter, and crucial winter/yearlong) describes any seasonal range or habitat component that has been documented as a determining factor in a population's ability to maintain itself at a specified level (theoretically at or above the population objective) over the long term. Crucial ranges are typically used 8 out of 10 winters. Spring/summer/fall ranges are used before and after winter conditions persist. Areas designated as OUT (or non-use areas) contain habitats of limited importance to the species.

Mule Deer. The project area lies within the Sublette Herd Unit. This unit covers 6,519 square miles of habitat in Sublette, Sweetwater, Fremont, Lincoln, and Teton counties (WGFD 1996). The 2001 posthunt population estimate for the herd unit was 34,700, well above the herd objective of 32,000 animals (WGFD 2002a). The project area is located within hunt area 138; 2001 hunter success in this area was 36.7% with a harvest of 296 mule deer bucks. Approximately 10% of the mule deer harvest in the Sublette Herd Unit was from hunt area 138 in 2001(WGFD 2002a). The Little Monument Project Area lies entirely within a portion of the herd unit which is classified as OUT (or non-use areas) containing habitats of limited importance to the species. As such, this document will not discuss mule deer further.

Elk. The project area lies within the 2,491.8-square mile Pinedale Herd Unit. The population objective for this herd unit is 1,900 and the 2001 posthunt estimated population was 1,926 animals (WGFD 2002a). The project area is located in hunt area 98, and in 2001 hunter success in this area was 33.6% with a harvest of 112 adult males, 24 yearling males, 34 juveniles, and 227 females. The LMPA lies entirely within a portion of the herd unit which is classified as OUT (or non-use areas) containing habitats of limited importance to the species. Therefore, elk will not be discussed further in this document.

Pronghorn Antelope. The project area lies within the Sublette Herd Unit. This unit occupies most of the Green River drainage north of Interstate 80 as well as portions of the Gros Ventre, Hoback and Sweetwater drainages. Some antelope in this herd unit migrate farther than any other known herd in North America (WGFD 2002b). The Sublette Herd Unit covers 10,546 square miles (11% of the state of Wyoming), and pronghorn occupy 7,983 square miles within the herd unit. The population objective for this herd unit is 48,000 and the 2001 posthunt population estimate was 47,700. Due to its large size, the Sublette Herd Unit is divided into 3 sub-units (North, South and West) for the purpose of analyzing data and making management recommendations on a more local level (WGFD 2002b). The LMPA is located within the North sub-unit which has the same geographic extent as hunt areas 85-90. In 2001, 1,346 antelope were harvested in the North sub-unit with a hunter success of 95%. All of the project area (3,857 acres) is classified as spring/summer/fall pronghorn range which is used before and after winter conditions persist (Figure 3-7).

Moose. The project area lies partially within the 5,804.5-square mile Sublette Herd Unit. The 2001 postseason population estimate for the herd unit (5,665) exceeds the population objective of 5,500 moose (WGFD 2002a). The project area is located within moose hunt area 25, and in 2001 hunter success in this hunt area was 91.6% with a harvest of 57 bulls, 42 females, and 10 juveniles. Approximately 128 acres (3.3%) of the project area lies within the Sublette Herd Unit. The remainder of the project area (3,729 acres) lies outside of any existing moose herd unit. The portion within the Sublette Herd Unit is classified as OUT (or non-use areas), containing habitats of limited importance to the species. Therefore, moose will not be discussed further in this document.

Big Game Summary. Overall, the project area is in habitats of limited importance to three of the four big game species (mule deer, elk, and moose). Maps of these herd units in relation to the project area can be found in Appendix B. The entire project area provides spring/summer/fall habitat for pronghorn antelope, which is used before and after winter conditions persist.

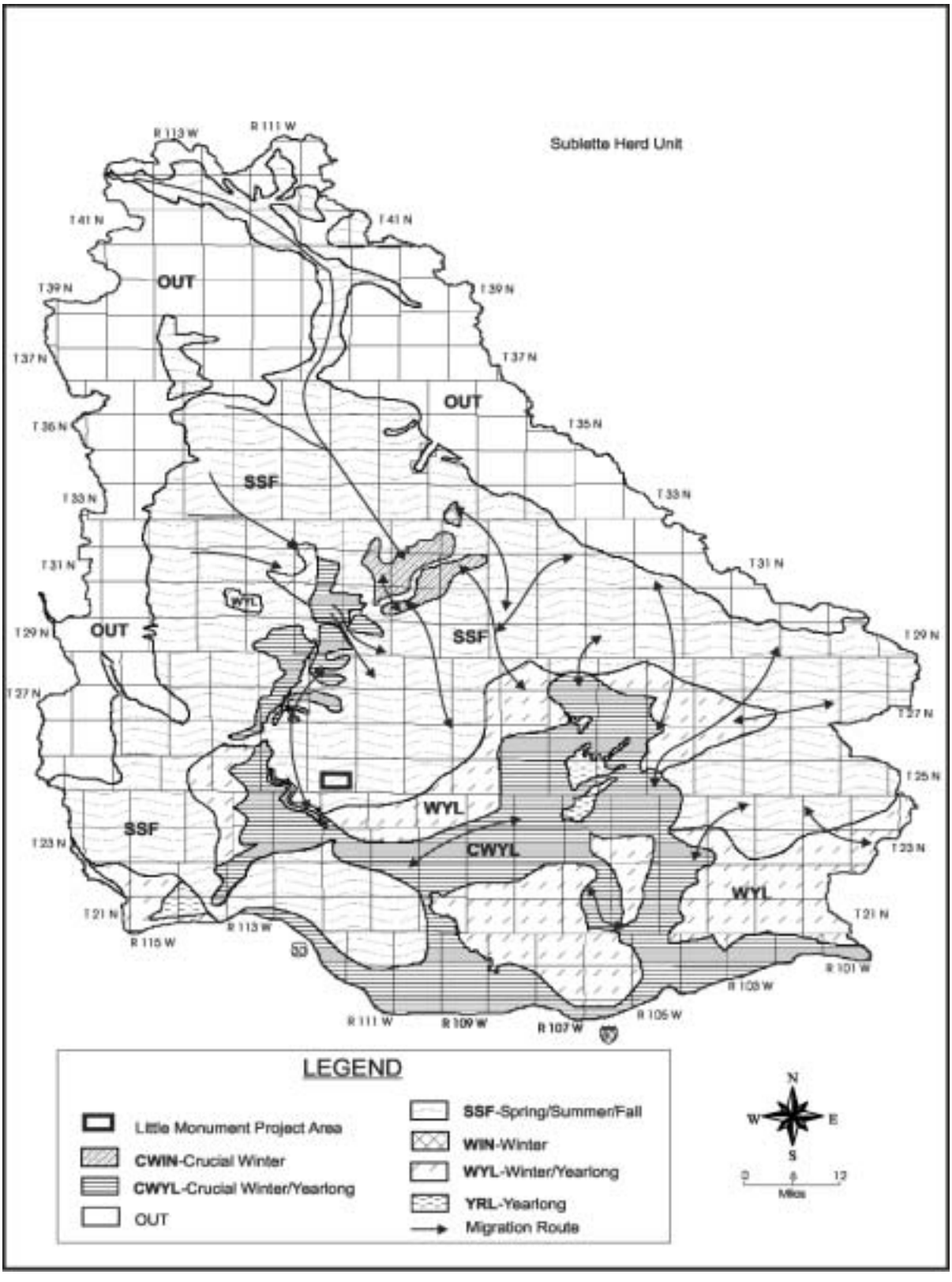


Figure 3-7. Sublette Pronghorn Herd Unit Seasonal Ranges in Relation to the LMPA.

3.7.5 Wild Horses

The proposed Little Monument project area lies within the Little Colorado Wild Horse Herd Management Area (HMA) which encompasses about 519,541 acres of BLM-administered public lands and represents about 0.7% of the total land surface area of the HMA. The majority of the HMA consists primarily of consolidated public lands with state school sections, and a large portion to the south belonging to the Bureau of Reclamation (Lloyd 2003). Boundaries of the Little Colorado HMA are the Big Sandy River on the south and the Green River on the west. The northern boundary is the Pinedale/Rock Springs Field Office boundary and Highway 191 establishes the eastern boundary. The area is unfenced except for portions of boundary fence between the RSFO and the Pinedale Field Office (PFO) management areas, and along Highway 191.

The BLM establishes an appropriate management level (AML) for each HMA. The AML is the population objective for the HMA that will ensure a thriving ecological balance among all the users and resources of the HMA. The Little Colorado HMA has an appropriate management level of 69- 100 horses. The population is currently estimated to be 123 horses according to a June 2003 census. With no known natural predators, the historical annual rate of increase in wild horse populations in the RSFO area is about 20 percent (USDI-BLM 1999a). The only human-made hazards to wild horses in the project area of importance would be fences, however, minimal fencing exists in the HMA and is mostly associated with deeded property or associated with major highways (i.e., Highway 191).

3.7.6 Upland Game Birds

The greater sage-grouse and mourning dove are the only upland game bird species known to occur on or around the project area, which lies within the Eden Upland Game Management Area (UGMA # 7).

Greater Sage-grouse. The greater sage-grouse is the upland game bird of primary interest in the project area. The RSFO of USDI BLM lists the greater sage-grouse as a sensitive species. The sage-grouse has declined over much of its range in the western states during recent years and may be petitioned for listing under the ESA by the USFWS. Populations in Wyoming have recently been in a decline due to a wide range of possible factors including drought, habitat loss, and habitat degradation.

The project area is located within the extensive sagebrush steppe habitat of southern Wyoming where sage-grouse are common. Important habitats for sage-grouse are strutting grounds (leks), nesting areas, brood-rearing areas, and wintering areas. All of these sage-grouse habitats may occur in a contiguous or patchy and disconnected pattern. Leks may be located between summer and winter ranges, but in some cases, summer and winter ranges may be the same (Call and Maser 1985). According to Call (1974), Braun et al. (1977), and Hayden-Wing et al. (1986), preferred nesting habitat is usually located within two miles of leks.

The estimated sage-grouse harvest in UGMA # 7 in 2001 was 2,456 sage-grouse, roughly 19.3% of the statewide harvest (WGFD 2002c). According to the RSFO, there are no known sage-grouse leks on or within two miles of the project area. The nearest known lek lies approximately ten miles to the north of the project area.

Mourning Dove. Mourning doves are found in the project area during the spring and summer months (WGFD 2002c) and are associated with sagebrush-grass, mountain shrub, and riparian habitats. Brood production is tied closely to spring and summer precipitation. Availability of sufficient seeds and water likely increases mourning dove productivity. The estimated mourning dove harvest for UGMA # 7 in 2001 was 560 (WGFD 2002c) out of 29,075 for the entire state.

3.7.7 Waterfowl and Shorebirds

Primary use of the project area by waterfowl and shorebirds is minimal because of the small amount of open water and wetlands available (Section 3.5.2). Although the habitat for waterfowl and shorebirds is quite limited in the project area, there is a possibility of incidental use by a number of different species because of suitable habitat within the region (Fontenelle Reservoir and Green River are approximately 3.5 miles west of the project area).

3.7.8 Raptors

According to the WOS data (WGFD 2002d), 12 raptor species have been observed on or within six miles of the Little Monument Project Area: bald eagle (*Haliaeetus luecocephalus*), burrowing owl (*Athene cunicularia*), ferruginous hawk (*Buteo regalis*), golden eagle (*Aquila chrysaetos*), great horned owl (*Bubo virginianus*), merlin (*Falco columbarius*), northern harrier (*Circus cyaneus*), osprey (*Pandion haliaetus*), prairie falcon (*Falco mexicanus*), red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), and Swainson's hawk (*Buteo swainsoni*). Data from the RSFO show no records of raptor nests on or within two miles of the project area (surveys done in 2000 and 2001).

3.8 SPECIAL STATUS WILDLIFE, FISH, AND PLANT SPECIES

Special status species include: (1) threatened, endangered, candidates, or those petitioned for listing as threatened or endangered by the FWS under the Endangered Species Act (ESA) of 1973, as amended; and (2) those designated by the BLM State Director as sensitive (USDI-BLM 2002).

3.8.1 Threatened, Endangered or Proposed for Listing Species of Wildlife, Fish, and Plants

The FWS has determined that one mammal, three birds, four fish, and one plant species listed as either threatened, endangered, candidate or proposed under the ESA may potentially be found in the project area or be affected by activities conducted on the project area (USDI-FWS 2002a). These species and their federal status under the ESA are listed in Table 3-10. The black-footed ferret, bonytail, Colorado pikeminnow, humpback chub, and razorback sucker are listed as endangered. The yellow-billed cuckoo is a candidate for listing as endangered under the ESA, and the bald eagle and Ute ladies'-tresses are classified as threatened. Four endangered fish species, which are downstream residents of the Colorado River System, are included in this analysis because of potential impacts to their habitat.

3.8.1.1 Mammals

Black-footed Ferret and Associated White-tailed Prairie Dog Colonies. The black-footed ferret's original distribution in North America closely corresponded to that of prairie dogs (Hall

and Kelson 1959, Fagerstone 1987). In Wyoming, white-tailed prairie dog (*Cynomys leucurus*) colonies provide essential habitat for black-footed ferrets. Ferrets depend almost exclusively on prairie dogs for food and they also use prairie dog burrows for shelter, parturition, and raising their young (Hillman and Clark 1980, Fagerstone 1987). Based upon communications with the RSFO and a query of species locations from the WYNDD (2002) and the WOS (WGFD 2002d), no white-tailed prairie dog colonies exist on the project area. Therefore, no habitat for black-footed ferrets exists within the LMPA. The BLM has made a "no effect" determination for presence of black-footed ferrets. Black-footed ferrets will not be given further consideration in this analysis.

3.8.1.2 Birds

Bald Eagle. Bald eagles typically build stick nests in the tops of coniferous or deciduous trees along streams, rivers, or lakes. Selection of nests likely depends upon availability of food in the early nesting season (Swenson et al. 1986). The habitat on the project area lacks large perennial water bodies and nesting trees for bald eagles, therefore nesting on the project area is not likely. Wintering areas are typically associated with concentrations of food sources including major rivers that remain unfrozen where fish and waterfowl are available and ungulate winter ranges where carrion is available. One record of bald eagle occurrence within six miles of the project area was recorded in the WOS in August, 1987 (WGFD 2002d) and according to RSFO, the nearest roosting habitat is approximately seven miles northwest of the LMPA, on the Green River. Although bald eagles could occasionally fly over or utilize the project area for hunting, this species would not be affected. Thus, the BLM has made a "no effect" determination and this species will not be given further consideration in this analysis.

Table 3-10. Threatened, endangered, proposed, and candidate species potentially Affected by or present on the Little Monument Project Area (USDI-FWS2002a)

Species	Scientific Name	Status
Mammals		
Black-footed ferret	*Mustela nigripes*	Endangered
Birds		
Bald eagle	*Haliaeetus leucocephalus*	Threatened
Yellow-billed Cuckoo	*Coccyzus americanus*	Candidate
Fish		
Bonytail	*Gila elegans*	Endangered
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered
Humpback chub	*Gila cypha*	Endangered
Razorback sucker	*Xyrauchen texanus*	Endangered
Plants		
Ute ladies'-tresses	*Spiranthes diluvialis*	Threatened

Yellow-billed Cuckoo. The yellow-billed cuckoo is a neotropical migrant that winters primarily in South America and migrates north into the United States during April and May. The yellow-billed cuckoo feeds primarily on large insects: caterpillars, katydids, cicadas, grasshoppers, and

crickets. Occasionally small frogs, lizards, eggs, and young birds are eaten (Hughes 1999). It is a riparian obligate species that requires at least 25 acres of mature riparian woodland, especially cottonwood (*Populus* spp.) or willow (*Salix* spp.) with low, dense undergrowth at elevations below 7,000 feet. The cuckoo prefers 100 acres or more of deciduous woodland at least 100 meters wide. Marginal habitat is at least 10 acres of riparian habitat more than 50 meters in width. Nests are located less than 8 meters above the ground in at least 2.5 acres of dense deciduous vegetation near water (Cerovski et al. 2001).

Due to the lack of adequate habitat on the project area and the fact that no records are documented within six miles of the project area (WGFD 2002d, WYNDD 2002) it is unlikely that the yellow-billed cuckoo occurs on the project area. This species will not be considered further in this analysis.

3.8.1.3 Fish Species

The project area is located in the Green River drainage of southwest Wyoming. The project area is drained by intermittent/ephemeral streams fed primarily by runoff of winter snows. Four federally endangered fish species may occur as downstream residents of the Colorado River system: bonytail, Colorado pikeminnow, humpback chub, and razorback sucker (USDI-FWS 2002a). However, these fish species are likely extirpated from the Colorado River system above Flaming Gorge Dam on the Green River (Baxter and Stone 1995). None of these four endangered fish species are likely to be found in streams and tributaries within the project area. However, the potential for project-related impacts (water quality or quantity reduction) to waters that feed into the Green River warrant their inclusion in this NEPA document.

Bonytail. Habitat of the bonytail is primarily limited to narrow, deep canyon-bound rivers with swift currents and white water areas (Valdez and Clemmer 1982, Archer et al. 1985, Upper Colorado River Endangered Fish Recovery Program 2002). Little is known about the specific habitat requirements of bonytail but it is thought that flooded bottomland habitats are important nursery and growth areas for young. Adults reach a maximum size of 550 mm (21.7 in) in length and 1.1 kg (2.4 lbs) in weight (USDI-FWS 2002b). With no known reproducing populations in the wild, the bonytail is thought to be the rarest of the endangered fishes in the Colorado River Basin. The bonytail was historically found in portions of the upper and lower Colorado River basins. Today, in the upper Colorado River Basin, only small, disjunct populations of bonytail are thought to exist in the Yampa River in Dinosaur National Monument, in the Green River at Desolation and Gray canyons, and in the Colorado River at the Colorado/Utah border and in Cataract Canyon (Upper Colorado River Endangered Fish Recovery Program 2002).

Colorado Pikeminnow. The Colorado pikeminnow is the largest member of the minnow family and occurs in swift, warm waters of Colorado Basin rivers. Adults attain a maximum size of approximately 1.8 meters (5.9 feet) in length and 36 kg (79.4 lbs) in weight (USDI-FWS 2002c). The species is adapted to rivers with seasonally variable flow, high silt loads, and turbulence. Pools and eddies outside the main current are used by adult pikeminnow. Backwater areas are inhabited by young-of-the-year. The species was once abundant in the main stem of the Colorado River and most of its major tributaries throughout Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, California, and Mexico. Today the species is primarily limited to the Green River below its confluence with the Yampa River; the lower Duchesne River in Utah; the Yampa River below Craig, Colorado; the White River from Taylor Draw Dam near Rangely, downstream to the confluence with the Green River; the Gunnison River in Colorado; and the

Colorado River from Palisade, Colorado, downstream to Lake Powell (Upper Colorado River Endangered Fish Recovery Program 2002); and there are small numbers of wild individuals, with limited reproduction, in the San Juan River subbasin. The Colorado pikeminnow has been reintroduced into the Gila River subbasin, where it exists in small numbers in the Verde River (USDI-FWS 2002c).

Humpback Chub. Humpback chub are restricted to deep, swift, canyon regions of the mainstem and large tributaries of the Colorado River Basin. Adults attain a maximum length of 480mm (18.9 in) and 1.2 kg (2.6 lbs) in weight (USDI-FWS 2002d). Historically, the humpback chub inhabited the canyons of the Colorado River and four of its tributaries: the Green, Yampa, White, and Little Colorado rivers. Now, two relatively stable populations are found in Westwater Canyon, Utah and Black Rocks, Colorado. Smaller numbers have been found in the Yampa and Green Rivers in Dinosaur National Monument, Desolation and Gray canyons on the Green River in Utah, Cataract Canyon on the Colorado River in Utah, and the Colorado River in Arizona. The largest known population is in the Little Colorado River in the Grand Canyon, where there may be up to 10,000 fish. There are no population estimates available for the rest of the upper Colorado River Basin (Upper Colorado River Endangered Fish Recovery Program 2002).

Razorback Sucker. The razorback sucker, an omnivorous bottom feeder, is one of the largest fishes in the sucker family reaching a length of 1 meter (3.3 ft) in length and 5-6 kg (11-13 lbs) in weight (USDI-FWS 2002e). Adult razorback sucker habitat use varies depending on season and location. Adults are adapted for swimming in swift currents, but they may also be found in eddies and backwaters away from the main current. Young require nursery habitats consisting of quiet, warm, shallow water, such as backwaters or inundated floodplains, river tributary mouths, and coves and shorelines in reservoirs (USDI-FWS 2002e). This species was once widespread throughout most of the Colorado River Basin from Wyoming to Mexico. Today, in the upper Colorado River Basin, populations of razorback suckers are only found in the upper Green River in Utah, the lower Yampa River in Colorado and occasionally in the Colorado River near Grand Junction. Small numbers of razorback suckers have also been found in Lake Powell, San Juan River, and Colorado River (Upper Colorado River Endangered Fish Recovery Program 2002).

3.8.1.4 Plant Species

Ute ladies'-tresses. The Ute ladies'-tresses (*Spiranthes diluvialis*), a threatened species, is a perennial, terrestrial orchid, endemic to moist soils near wetland meadows, springs, lakes, and perennial streams. It occurs generally in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows at elevations from 4,200 to 7,000 feet. The orchid colonizes early successional riparian habitats such as point bars, sand bars, and low lying gravelly, sandy, or cobbly edges, persisting in those areas where the hydrology provides continual dampness in the root zone through the growing season. It is known to occur in a number of locations in Daggett County, Utah, with the closest being about 90 miles south of the project area. Other known locations include along the Snake River in Idaho, and more than 100 miles south of the Rock Springs area. According to the RSFO, suitable habitat for this species on the LMPA is not present. Therefore, the BLM has made a "no effect" determination. This species will not be given further consideration in this document.

3.8.2 Sensitive Wildlife, Fish, and Plant Species

Although these species have no legal protection under the ESA, the BLM and FWS still maintain an active interest in their numbers and status. Sensitive species are those included on the BLM Wyoming State sensitive species list (USDI-BLM 2002). The BLM views "management of sensitive species as an opportunity to practice pro-active conservation; this management should not be onerous, or a show-stopper of other legitimate, multiple use activities" (USDI-BLM 2002). The BLM's order of priority for the management of all special status species is: First - listed T&E species; Second - proposed T&E species; Third - candidate T&E species; Fourth - BLM sensitive species; and, Fifth - State listed species. The BLM Wyoming Sensitive Species list is meant to be dynamic, and the list will be reviewed annually. The plant, wildlife, and fish species and their sensitivity status/rank, and probability of occurrence in the LMPA are listed in Table 3-11. A summary discussion of these species follows. In addition, the RSFO identified several of these species to be considered in more detail.

3.8.2.1 Mammals

Nine sensitive mammal species may potentially be found on the LMPA (USDI-BLM 2002, Table 3-11). These include: Idaho pocket gopher, Wyoming pocket gopher, pygmy rabbit, white-tailed prairie dog, swift fox, spotted bat, fringed myotis, long-eared myotis, and Townsend's big-eared bat. The RSFO identified three of these species that should be considered in more detail: swift fox, Wyoming pocket gopher, and pygmy rabbit.

Swift Fox. The swift fox inhabits short grass and mid-grass prairies over most of the Great Plains including eastern Wyoming (Clark and Stromberg 1987). In eastern Wyoming and portions of northeastern Colorado, the species is most common in areas with relatively flat to gently rolling topography (Fitzgerald et al. 1994, Olson 2000). Swift foxes prey on a variety of small rodents, lagomorphs, birds, and insects (Cutter 1958, Olson 2000). This species has been studied in Wyoming (Olson 2000), and recent surveys conducted by Woolley et al. (1995) show that it is much more widely distributed in Wyoming than previously thought. Woolley's studies have documented occurrences in northeastern Sweetwater County but his study area did not include the Little Monument Project Area in northwestern Sweetwater County. Olson et al. (1997) ran track plots and conducted spotlight surveys which included BLM Road No. 4202, where it passes through the western edge of the project area. No swift fox were reported during the 1997 surveys on or in the vicinity of the project area (Olson et al. 1997).

No records of swift fox were documented in the WOS (WGFD 2002d) or WYNDD (WYNDD 2002) within six miles of the project area, however, the WGFD conducted a trapper survey in 1995 resulting in some reported sightings west of the Fontenelle Reservoir (Woolley et al. 1995). Although the majority of the project area is not ideal habitat, some portions of the project area may provide limited foraging habitat for swift fox.

Wyoming Pocket Gopher. Little is known about the Wyoming pocket gopher. The species is the only mammal restricted to Wyoming, and the only known populations occur in the southcentral portion of the state (Clark and Stromberg 1987).

Like all pocket gophers, the Wyoming pocket gopher spends most of its life underground. The species is frequently found along dry ridge tops and is associated with gravelly, loose soils and greasewood vegetation communities (*Sarcobatus* spp.) (Clark and Stromberg 1987). Within these habitats, the Wyoming pocket gopher digs two types of tunnels: (1) deep burrows with

chambers used for shelter, nesting, food storage, and deposition of fecal material, and (2) long, winding, and shallow tunnels used to forage roots, tubers, and other vegetation material from above (Nowak 1999). The shallow food tunnels are often visible from the ground surface and are useful in detecting the presence of pocket gophers. The limited behavioral information available on the species suggests that except during the breeding season, Wyoming pocket gophers lead solitary lives with only one individual per burrow system (Nowak 1999).

Limited potential habitat exists within the project area for Wyoming pocket gophers. Although the species has not been documented within a six-mile radius of the project area (WGFD 2002d, WYNDD 2002), its fossorial behavior does make the Wyoming pocket gopher difficult to detect.

Pygmy Rabbit. The former range of the pygmy rabbit was thought to be limited to portions of Idaho and Utah until their presence was confirmed in southwest Wyoming (Campbell et al. 1982). Pygmy rabbit sightings were documented by Hayden-Associates (HWA) in 1994, south of Fontenelle Reservoir in eastern Lincoln and western Sweetwater Counties (HWA 1994). Pygmy rabbits are limited to areas of dense and tall big sagebrush in predominantly sandy soils (Campbell et al. 1982, Clark and Stromberg 1987, Heady et al. 2002). Burrows are located in areas with greater cover, higher shrub density, taller vegetation, and greater forb cover (Heady et al. 2002).

No pygmy rabbit records within six miles of the project area were documented in the WOS (WGFD 2002d) or the WYNDD (WYNDD 2002). The project area is primarily dominated by Wyoming big sagebrush and it is possible that pygmy rabbits could occur on the project area.

3.8.2.2 Birds

Thirteen sensitive bird species may potentially be found on the LMPA (USDI-BLM 2002, Table 3-11). These include: sage sparrow, Brewer's sparrow, long-billed curlew, sage thrasher, western burrowing owl, loggerhead shrike, greater sage-grouse (see Section 3.7.6), white-faced ibis, trumpeter swan, peregrine falcon, ferruginous hawk, mountain plover, and northern goshawk. The following species have been considered in more detail because of the possibility of occurrence on the LMPA: sage thrasher, loggerhead shrike, Brewer's sparrow, sage sparrow, mountain plover, and white-faced ibis.

Sage Thrasher. The sage thrasher generally occurs within shrub-dominated valleys and plains of the western United States and is considered a sagebrush (*Artemesia* spp.) obligate. Insects are the primary food source and foraging occurs almost exclusively on the ground. For successful breeding the sage thrasher requires large patches of sagebrush steppe habitat and typically nest in taller shrubs with wider crowns (Reynolds et al. 1999).

Suitable habitat exists in the area, however there are no records of sage thrashers occurring within six miles of the project area (WGFD 2002d). It is likely that sage thrashers use the larger patches of taller sagebrush within the project area.

Loggerhead Shrike. The loggerhead shrike is a small avian predator that hunts from perches and impales its prey on thorns, barbed wire fences, and other sharp objects (Yosef 1996). It prefers open country within close proximity to brushy areas containing trees or shrubs taller than six feet for nesting (Dinsmore 1983). It breeds in basin-prairie shrublands, sagebrush grasslands, mountain-foothills shrublands, pine-juniper woodlands, and woodland chaparral.

Brewer's Sparrow. Most Brewer's sparrows breed in the Great Basin area of the western United States and winter in the Sonoran and Chihuahuan deserts of southwestern United States and Mexico (Rotenberry et al. 1999). Breeding habitat is closely associated with landscapes dominated by Wyoming big sagebrush with an average nest - shrub height of 0.5 meters. Nests are located less than 1.2 meters high in live sagebrush or on the ground at the base of a live sagebrush shrub. The Brewer's sparrow is a common cowbird host and parasitized nests are sometimes deserted (Cerovski et al. 2001).

No records of Brewer's sparrows are documented within six miles of the project area (WGFD 2002d, WYNDD 2002). However, it is likely that Brewer's sparrows breed within the sagebrush

Table 3-11. Sensitive Wildlife, Fish, and Plant Species Potentially Present in the LMPA.[1]

Wildlife Species			
Common Name	**Scientific Name**	**Sensitivity Status[2]**	**Occurrence Potential[3]**
Mammals			
Idaho pocket gopher	*Thomomys idahoensis*	G4/S2?, NSS3	Unlikely
Wyoming pocket gopher	*Thomomys clusius*	R2, G2/S1S2, NSS4	Possible
Pygmy rabbit	*Brachylagus idahoensis*	G4/S2, NSS3	Possible
White-tailed prairie dog	*Cynomys leucurus*	G4/S2S3, NSS3	Unlikely
Swift fox	*Vulpes velox*	R2, G3/S2A3	Possible
Spotted bat	*Euderma maculatum*	R2/R4,G4/S1B, SZ?N, NSS2	Unlikely
Fringed myotis	*Myotis thysanodes*	R2, G5/S1B, S1N, NSS2	Unlikely
Long-eared myotis	*Myotis evotis*	G5/S1B, S1?N, NSS2	Unlikely
Townsend's big-eared bat	*Corynorhinus townsendii*	R2/R4, G4/S1B, S2N, NSS2	Unlikely
Birds			
Sage sparrow	*Amphispiza belli*	G5/S3B, SZN	Likely
Brewer's sparrow	*Spizella breweri*	G5/S3B, SZN	Likely
Long-billed curlew	*Numenius americanus*	G5/S3B, SZN, R2, NSS3	Unlikely
Sage thrasher	*Oreoscoptes montanus*	G5/S3B, SZN	Likely
Mountain Plover	*Charadrius montanus*	G2/S2B,SZN	Unlikely
Western burrowing owl	*Athene cunicularia*	R2, G4/S3B, SZN, NSS4	Unlikely
Loggerhead shrike	*Lanius ludovicianus*	G5/S4B, SZN, R2	Possible
Greater sage-grouse	*Centrocercus urophasianus*	G5/S3	Likely
White-faced ibis	*Plegadis chihi*	G5/S1B, SZN, R2, NSS3	Unlikely
Trumpeter swan	*Cygnus buccinator*	R2/R4, G4/S1B, S2N, NSS2	Unlikely
Peregrine falcon	*Falco peregrinus*	G4/T3/S1B, S2N, R2, NSS3	Unlikely
Ferruginous hawk	*Buteo regalis*	R2, G4/S3B, S3N, NSS3	Possible
Northern goshawk	*Accipiter gentilis*	R2/R4, G5/S23B, S4N, NSS4	Unlikely
Reptiles			
Midget-faded rattlesnake	*Crotalus viridis concolor*	G5T3/S1S2	Unlikely
Amphibians			
Boreal toad	*Bufo boreas boreas*	G4T4/S2, R2, R4, NSS2	Unlikely
Great Basin spadefoot toad	*Spea intermontanus*	G5/S4, NSS4	Possible
Northern leopard frog	*Rana pipiens*	G5/S3, R2, NSS4	Unlikely
Spotted frog	*Rana pretiosa*	G4/S2S3, R2, R4, NSS4	Unlikely
Fish			
Leatherside chub	*Gila copei*	G3G4/S2, NSS1	Unlikely
Roundtail chub	*Gila robusta*	G2G3/S2?, NSS1	Unlikely
Bluehead sucker	*Catostomus discobolus*	G4/S2S3, NSS1	Unlikely
Flannelmouth sucker	*Catostomus latipinnis*	G3G4/S3, NSS1	Unlikely
Colorado River cutthroat trout	*Oncorhynchus clarki pleuriticus*	R2/R4, G4T2T3/S2, NSS2	Unlikely

Plant Species				
Common Name	**Scientific Name**	**Sensitivity Status[2]**	**Habitat**	**Occurrence Potential[3]**
Meadow pussytoes	*Antennaria arcuata*	GS/S2	Moist, hummocky meadows, seeps or springs surrounded by sage/grasslands 4,950-7,900'	low
Small rock cress	*Arabis pusilla*	G1/S1 Removed from Federal Candidate list 10/25/99	Cracks/crevices in sparsely vegetated granite/pegmalile outcrops within sage/grasslands 8,000-8,100'	low
Mystery wormwood	*Artemisia biennis var. diffusa*	G5T1/S1	Clay flats and playas 6,500'	low
Nelson's milkvetch	*Astragalus nelsonianus*	G2/S2 CO	Alkaline clay flats, shale bluffs and gullies, pebbly slopes, and volcanic cinders in sparsely vegetated sagebrush, juniper, and cushion plant communities at 5,200-7,600'	low
Precocious milkvetch	*Astragalus proimanthus*	G1/S1, BLM	Cushion plant communities on rocky, clay soils mixed with shale on summits and slopes of white shale hills at 6,800-7,200 feet.	low
Cedar Rim thistle	*Cirsium aridum*	G2Q/S2	Barren, chalky hills, gravelly slopes and fine textured, sandy-shaley draws 6,700-7.200'	possible
Ownbey's thistle	*Cirsium ownbeyi*	G3/S2	Sparsely vegetated shaley slopes in sage and juniper communities 6,440-8,400;	low
Wyoming tanseymustard	*Descurania torulosa*	G1/S1	Sparsely vegetated sandy slopes at base of cliffs of volcanic breccia or sandstone 8,300-10,000'	low
Large-fruited bladderpod	*Lesquerella macrocarpa*	G2/S2	Gypsum-clay hills and benches, clay flats, and barren hills 7,200-7,700'	low
Stemless beardtongue	*Penstemon acaulis var. acaulis*	G3T2/S1	Cushion plant or black sage grassland communities on semi-barren rocky ridges, knolls, and slopes at 6,500-7,000'	low
Beaver Rim phlox	*Phlox pungens*	G2/S2	Sparsely vegetated slopes on sandstone, siltstone, or limestone substrates 6,000-7,600'	possible
Tufted twinpod	*Physaria condensata*	G2/S2	Sparsely vegetated shale slopes and ridges 6,500-7,000''	possible
Green River greenthread	*Thelesperma caespitosum*	G1/S1	White shale slopes and ridges of Green River Formation 6,300'	low
Uinta greenthread	*Thelesperma pubescens*	G1/S1 FSR4	Sparsely vegetated benches and ridges on coarse, cobbly soils of Bishop Conglomerate 8,500'	low
Cedar Mountain Easter daisy	*Townsendia mircrocephala*	G1/S1	Rocky slopes of Bishop Conglomerate 8,500'	low
Trelease's racemose milkvetch[4]	*Astragalus racemosus var. treleasei*	G5T2/S1	Habitat requirement research in progress	possible

[1] - Source: USDI-BLM (2002).
[2] - Definition of sensitivity status:

G Global rank: Rank refers to the range-wide status of a species.
T Trinomial rank: Rank refers to the range-wide status of a subspecies or variety.
S State rank: Rank refers to the status of the taxon (species or subspecies) in Wyoming. State ranks differ from state to state.
1 Critically imperiled because of extreme rarity (often known from 5 or fewer extant occurrences or very few remaining individuals) or because some factor of a species' life history makes it vulnerable to extinction.
2 Imperiled because of rarity (often known from 6-20 occurrences) or because of factors demonstrably making a species vulnerable to extinction.
3 Rare or local throughout its range or found locally in a restricted range (usually known from 21-100 occurrences).
4 Apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
5 Demonstrably secure, although the species may be rare in parts of its range, especially at the periphery.
H Known only from historical records. 1950 is the cutoff for plants; 1970 is the cutoff date for animals.
X Believed to be extinct.
A Accidental or vagrant: A taxon that is not known to regularly breed in the state or which appears very infrequently (typically refers to birds and bats).
B Breeding rank: A state rank modifier indicating the status of a migratory species during the breeding season (used mostly for migratory birds and bats)
N Nonbreeding rank: A state rank modifier indicating the status of a migratory species during the non-breeding season (used mostly for migratory birds and bats)
ZN or ZB Taxa that are not of significant concern in Wyoming during breeding (ZB) or non-breeding (ZN) seasons. Such taxa often are not encountered in the same locations from year to year.
U Possibly in peril, but status uncertain; more information is needed.
Q Questions exist regarding the taxonomic validity of a species, subspecies, or variety.
? Questions exist regarding the assigned G, T, or S rank of a taxon.
R2 Designated sensitive in U.S. Forest Service Region 2 (Rocky Mountain Region).
R4 Designated sensitive in U.S. Forest Service Region 4 (Intermountain Region).

WGFD Native Species Status Codes - Fish and Amphibians

NSS1 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitats are declining or vulnerable. Extirpation appears possible. The Wyoming Game and Fish Commission mitigation category for Status 1 species is "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.
NSS2 - Populations are physically isolated and/or exist at extremely low densities throughout range. Habitat conditions appear to be stable. The Wyoming Game and Fish Commission mitigation category for Status 2 species is also "Vital". The mitigation objective for this resource category is to realize "no loss of habitat function". Under these guidelines, it will be very important that the project be conducted in a manner that avoids alteration of habitat function.
NSS3 - Populations are widely distributed throughout its native range and appear stable. However, habitats are declining or vulnerable. The Wyoming Game and Fish Commission mitigation category for Status 3 species is "High". The mitigation objective for this resource category is to realize "no net loss of habitat function within the biological community which encompasses the project site". Under these guidelines, it will be important that the project be conducted in a manner that either avoids the impact, enhances similar habitat or results in the creation of an equal amount of similarly valued fishery habitat.
NSS4-7 - Populations are widely distributed throughout native range and are stable or expanding. Habitats are also stable. There is no special concern for these species.
WGFD Native Species Status Codes - Birds and Mammals
NSS1 - Populations are greatly restricted or declining, extirpation appears possible. AND On-going significant loss of habitat.
NSS2 - Populations are declining, extirpation appears possible; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; ongoing significant loss of habitat.
NSS3 - Populations are greatly restricted or declining, extirpation appears possible; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance. OR Species is widely distributed; population status or trends are unknown but are suspected to be stable; on-going significant loss of habitat.
NSS4 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance. OR Species is widely

distributed, population status or trends are unknown but are suspected to be stable; habitat is restricted or vulnerable but no recent or on-going significant loss; species may be sensitive to human disturbance.
NSS5 - Populations are declining or restricted in numbers and/or distribution, extirpation is not imminent; habitat is stable and not restricted. OR Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is not restricted, vulnerable but no loss; species is not sensitive to human disturbance.
NSS6 - Species is widely distributed, population status or trends are unknown but are suspected to be stable; habitat is stable and not restricted.
NSS7 - Populations are stable or increasing and not restricted in numbers and/or distribution; habitat is stable and not restricted.

[3] - Occurrence potential based upon presence of habitat, known distribution, and personal communications with RSFO biologists J. Dunder (wildlife) and J. Glennon (botany).
[4] BLM is updating the 2002 Sensitive Species List to reflect this addition (Glennon 2003**).**

habitats that exist on the project area. Nests are located 1-5 feet above the ground regardless of shrub height. The loggerhead shrike feeds primarily on grasshoppers and other large insects although some small mammals and birds are also taken. Areas of low vegetation or bare ground are preferred foraging habitat (Cerovski et al. 2001).

No records of loggerhead shrikes are documented within six miles of the project area (WGFD 2002d), but it is possible that loggerhead shrikes utilize portions of the project area during the nesting season.

Sage Sparrow. The sage sparrow prefers semi-open habitats with evenly spaced shrubs 1-2 meters high. Although closely associated with Wyoming big sagebrush, the sage sparrow will utilize sagebrush communities interspersed with other shrub species, such as bitterbrush (*Purshia tridentata*), saltbush (*Atriplex* spp.), shadscale (*Atriplex confertifolia*), rabbitbrush (*Chrysothamnus* spp.), or greasewood (Martin and Carlson 1998). Sage sparrows nest in shrubs up to one meter high and require a large block of unfragmented habitat to breed successfully (Cerovski et al. 2001).

No records of sage sparrows are documented within six miles of the project area (WGFD 2002d, WYNDD 2002). The project area is dominated by Wyoming big sagebrush and it is possible that sage sparrows occur on the project area.

Mountain Plover. The mountain plover nests over much of Wyoming, but its preferred habitat may be limited throughout its range in the state (Oakleaf et al. 1982, Dinsmore 1983, Leachman and Osmundson 1990). This ground-nesting species is typically found in areas of short (less than four inches) vegetation on slopes of less than three percent. Any short grass, very short shrub, or cushion plant community could be considered plover nesting habitat (Parrish et al. 1993), however, mountain plovers prefer shortgrass prairie with open, level or slightly rolling areas dominated by blue grama and buffalograss (Graul 1975, Dinsmore 1981, Dinsmore 1983, Kantrud and Kologiski 1982). These habitats are quite often associated with prairie dog colonies, and researchers have found that plovers use prairie dog colonies more often than other areas (Knowles et al. 1982, Knowles and Knowles 1984, Olson and Edge 1985). Loss of wintering and breeding habitats and prey-base declines from pesticide use are thought to be factors contributing to the decline of mountain plovers on the North American Continent (Wiens and Dyer 1975, Knopf 1994).

No mountain plover records within the six-mile buffer of the project area were reported in the WOS (WGFD 2002d) or WYNDD (WYNDD 2002). While not providing ideal mountain plover

habitat, some portions of the project area may provide limited nesting opportunities for mountain plovers.

White-faced Ibis. White-faced ibis feed in wet meadows and shallow water found along streams and lakes. They nest in areas with extensive water, which is required for successful reproduction, and build their nests in heavy emergent vegetation such as cattail and reed (Erwin 1983).

Five records of white-faced ibis are documented within six miles of the project area (WYNDD 2002, WGFD 2002d). The few small ephemeral streams found within the project area would not provide suitable habitat for this species, therefore white-faced ibis are not expected to nest on the project area.

3.8.2.3 Reptiles

No records of midget-faded rattlesnakes are documented within six miles of the project area (WGFD 2002d, WYNDD 2002). They may potentially be found on the LMPA (USDI-BLM 2002, Table 3-11), but the likelihood is very low.

3.8.2.4 Amphibians

Four sensitive amphibian species may potentially be found on the LMPA (USDI-BLM 2002, Table 3-11). The boreal toad, northern leopard frog, and spotted frog are unlikely to occur on the LMPA; the Great Basin spadefoot toad has a slight potential to occur.

Great Basin Spadefoot Toad. In Wyoming the Great Basin spadefoot occurs in sagebrush communities mostly west of the Continental Divide (Baxter and Stone 1980). They are dormant in fall and winter and their emergence in spring may be triggered by moisture in the burrow. Spadefoots may extend their dormancy period during drought for long periods of time. Breeding occurs during spring and early summer in permanent and temporary waters, including playas that develop after heavy rains and spring runoff pools. Males usually emerge from burrows after spring rains to breed, although Great Basin spadefoots do breed during periods of no rain. The stimulus for emergence for breeding in the absence of rain is unknown. Adult spadefoots are opportunistic carnivores and emerge from their burrows at night to forage for insects, arachnids, and snails only when the air is humid enough for dew to collect or during light rains (Howard 1996).

The Great Basin spadefoot has not been documented within six miles of the project area (WGFD 2002d, WYNDD 2002). Although limited habitat exists in the area it is possible that Great Basin spadefoots occur on the project area and utilize the intermittent and temporary water sources for breeding during years with adequate moisture.

3.8.2.5 Fish

Five sensitive fish species may potentially be found downstream of the LMPA. These include: leatherside chub, roundtail chub, bluehead sucker, flannelmouth sucker, and Colorado River cutthroat trout. These species are unlikely to occur on the LMPA due to a lack of suitable habitat. However, they do occur downstream of the LMPA and are therefore considered in this document.

3.8.2.6 Plants

Sixteen BLM Wyoming state sensitive plant species may be found in the RSFO Area (USDI-BLM 2002). A summary of status, habitat associations, and potential of occurrence in the project area for these sensitive species is given in Table 3-11. Of these species, four have the potential to occur in the project area: Cedar Rim thistle (*Cirsium radium*), Beaver Rim phlox (*Phlox pungens*), tufted twinpod (*Physaria condensata*), and Trealease's racemose milkvetch (*Astragalus racemosus var. treleasei*).

Cedar Rim Thistle. This thistle can be found on barren, chalky hills, gravelly slopes, and fine-textured, sandy shaley draws between 6,700 and 7,200 ft.

Beaver Rim Phlox. Beaver Rim phlox prefers sparely vegetated slopes on sandstone, siltstone, or limestone substrates at elevations between 6,000 and 7,000 ft.

Tufted Twinpod. Tufted twinpod occurs in sparsely vegetated slopes and ridges between 6,500 and 7,000 ft.

Trealease's racemose milkvetch. This milkvetch occurs primarily in sparsely-vegetated outwash flats and fluted Badlands slopes at 6,500 to 7,500 ft. Most populations are found on pale whitish or grey silty loams derived from shales.

The occurrence and distribution of these species will require specific consideration in the planning of the proposed project as discussed in Chapter 4.

3.9 RECREATION

The LMPA and surrounding areas provide opportunities for dispersed recreation activities such as hunting (big game and sage grouse), wildlife viewing, rock hounding and off-road vehicle (ORV) use. Nearby Fontenelle Reservoir offers a variety of recreation opportunities and receives substantial use; most recreation use in the general area is related to Fontenelle Reservoir and the Green River. Recreation use of the LMPA is believed to be minimal (Foster 2003). There are no special recreation management areas, designated recreation use areas, developed recreation facilities or scenic or historic trails within the LMPA.

3.10 VISUAL RESOURCES

The LMPA is located in within the Wyoming Basin physiographic province and lies within the Colorado-Sandy Landscape. The topography is gently rolling with infrequent and indistinct drainages that are below the normal view. These drainages are often deep with steep banks. The landscape is characterized by light-brown to brown fine-textured soils and low, grey, finely textured vegetation, primarily sagebrush with intermittent occurrences of lower growing half-shrubs (USDI - BLM 1995).

Human viewers of the LMPA are primarily oil and gas workers and, less frequently, hunters and other recreationists. Because of distance and higher elevation, the LMPA is not visible from Fontenelle Reservoir. Higher elevations within the LMPA offer dramatic views of the Wind River Mountains to the northeast and east and Commissary Ridge to the west. Existing cultural

modifications within the LMPA include extensive oil and gas field development (roads, well pads, wellhead facilities and production facilities). The LMPA is situated about six miles north of the Oregon Trail and about nine miles to south of the Sublette Cutoff of the Oregon Trail, and is outside the viewshed of both trails.

According to the RMP, the region which contains the LMPA has been designated as Visual Resource Management (VRM) Class IV, which allows for major modification of the existing character of the landscape. The level of change within Class IV areas may be high and management activities may dominate the view and be the major focus of attention. As with all VRM classes, surface disturbing activities must include appropriate mitigation measures to reduce visual impacts. Mitigation is achieved by designing and locating disturbances to most closely meet the minimum degree of contrast acceptable for the VRM class.

3.11 CULTURAL AND HISTORIC RESOURCES

Management Objectives

The objectives for the management of the cultural and paleontological resources are to:

- Expand the opportunities for scientific study, and educational and interpretive uses of cultural and paleontological resources;
- Protect and preserve important cultural and paleontological resources and/or their historic record for future generations; and
- Resolve conflicts between cultural/paleontological resources and other resource uses.

Of particular concern are significant sites of historic or prehistoric human habitation, sites demonstrating unique ethnic affiliation, places having traditional cultural significance to Native Americans, and vertebrate fossil localities (USDI-BLM 1997).

3.11.1 Cultural Chronology of Area

Archaeological investigations in the Green River Basin indicate the area has been inhabited by prehistoric people for at least 10,000 years from Paleoindian occupation to the present. The accepted cultural chronology is based on a model for the Wyoming Basin by Metcalf (1987) and revised by Thompson and Pastor (1995). The Wyoming Basin prehistoric chronology is documented in Table 3-12. Not all sites discussed below are located in the project area.

Paleoindian Period

The oldest period for which there is solid archaeological evidence is the Paleoindian, beginning ca. twelve thousand years before present (YBP) and ending around 8500 YBP. This is the transition period from the periglacial conditions of the Wisconsin ice advance during the terminal Pleistocene to the warmer and drier climatic conditions of the Holocene. A savanna-like environment with higher precipitation than occurs today was prevalent in southwest Wyoming. Archaeological research has focused on understanding paleoenvironmental conditions operating at the end of the Pleistocene and into the Holocene to provide insights into the articulation between human populations and the environment (Thompson and Pastor 1995). Paleoindian sites are rare in southwest Wyoming. The Blue Point Site (48SW5734), located

Table 3-12. Prehistoric chronology of the Wyoming Basin.

Period	Phase	Age (YBP)
Paleoindian		12,000 - 8500
Early Archaic	Great Divide	8500 - 6500
	Opal	6500 - 4300
Late Archaic	Pine Spring	4300 - 2800
	Deadman Wash	2800-2000/1800
Late Prehistoric	Uinta	2000/1800 - 650
	Firehole	650 - 300/250
Protohistoric		300/250 - 150

Source: Metcalf (1987), as modified by Thompson and Pastor (1995)

south of the project area along a playa lake, contained Paleoindian projectile points and dates to 9540 YBP (Johnson, in prep.). However, isolated surface finds of Paleoindian projectile points are not uncommon and suggest that site preservation or visibility may be factors affecting the number of known sites. The Paleoindian tool assemblage includes lanceolate points, gravers, and end-scrapers.

Archaic Period

Settlement and subsistence practices, in southwest Wyoming, remained largely unchanged from the end of the Paleoindian period through the Archaic and continued until at least the introduction of the horse, or even until Historic Contact. Reduced precipitation and warmer temperatures were in place by ca. 8500 YBP. The environmental change at the end of the Paleoindian period led to a pattern of broad spectrum resource exploitation which is reflected in the more diverse subsistence and settlement practices of the Archaic period.

The Archaic period is divided into the Early and the Late periods and subdivided in the Great Divide and Opal and the Pine Spring and Deadman Wash phases, respectively. Large side- and corner-notched dart points used for hunting are temporally diagnostic artifacts of the Archaic period. The earliest dated occurrence of side-notched points are Component I at the Maxon Ranch site dating between 6400 - 6000 YBP (Harrell and McKern 1986). Large side-notched points from the Great Basin and Colorado Plateau occur as early as 7000 years YBP. The presence of ground stone implements suggests a greater use of plant resources during the

Archaic period. Faunal assemblages from Archaic period components document increased use of small animals (Thompson and Pastor 1995). Slab-lined features and housepits are also prevalent during this period.

Several sites located near the project area contain Archaic components. The Vegan site (McKern and Creasman 1991) dates to 7570 and 8400 YBP and contains lithic material, ground stone, and bone scrap. The Taliaferro site (Smith and Creasman 1988) also had Archaic components that produced large and small mammal bone, floral remains, structures, and large side-notched points.

Late Prehistoric Period

The Late Prehistoric period is between 2000 - 250 YBP and is subdivided into the Uinta and the Firehole phases. Large-scale seed processing and an increase in the number of features is noted in the Late Prehistoric period as is the presence of pottery and the introduction of the bow and arrow technology. A characteristic of the Uinta phase is clusters of semi-subterranean structures dating to ca. 1500 YBP. The Pescadero site is located north of the Hams Fork River, south of the study area. The Pescadaro site (48LN2068) exhibited many Uinta phase characteristics such as lignite stone beads, ground stone tools, bone awls, bone pendents and bead fragments, notched pebbles, Rose Spring points, chipped stone tools, flakes, and faunal remains (McKibbin 1995). The Firehole phase is distinguished from the preceding Uinta phase by a dramatic decline in radiocarbon dates possibly related to a decline in population density. The Cow Hollow Creek (Schock et al. 1982) and Skull Point (McGuire 1977) sites are located in southwest Wyoming and date to the Firehole phase.

Protohistoric Period

The Protohistoric period begins sometime after 300 years YBP with the first European trade goods to reach the area, and ends with the development of the Rocky Mountain fur trade 150 years ago. The Wyoming Basin was the heart of Shoshone territory during this period, with occasional forays into the area by other groups such as the Crow and Ute (Smith 1974). The most profound influence on native cultures during this time was the introduction of the horse enabling Native Americans to expand their range. All forms of rock art denoting horses, metal implements, and other Euro-American goods are associated with the Protohistoric period. Metal projectile points have been recovered from both surface and subsurface contexts in southwest Wyoming. Site 48LN434, located east of the project area, contained a protohistoric metal projectile point (Schoen 1986).

Historic Period

Historic use of the project area is limited to westward expansion, ranching/grazing activities, and fur trapping and trading activities associated with the Green River. No corrals, ranches, or local roads are shown on the 1892 GLO maps and no historic sites have been recorded in the project area. Several water wells are noted on various maps of the general area but none in the project area. Fur trapping and trading occurred at the confluence of the Hams Fork and the Blacks Fork rivers, ca. 40 miles to the south and on the Green River to the west of the project area as early as 1834. Names Hill, a stone face bearing the alleged name of mountain man/fur trader Jim Bridger, is located along the Green River ca. 7 miles west of the project area. Table 3-13 summarizes the historic chronology of the area.

The Sublette Cutoff (48LN225/48SW1841), a variant of the Oregon Trail is located a little over one mile to the north and 2.5 miles to the west of the project area. “In November 1978, with the passage of an amendment (Public Law 95-625) to the National Trail System Act (Public Law 90-543), the Oregon and Mormon Pioneer Trails were designated as National Historic Trails by Congress” (USDI-BLM 1986). This act protects the trail remnants, variants, and artifacts. However, the entire six sections in question are covered under the Blue Forest Memorandum of Agreement (MOA). This MOA between the BLM and the SHPO establishes an area within which the setting of the Sublette and Kinney cutoffs is determined as being non-contributing due to extensive existing gas development (Del Bene email communication 2003).

3.11.2 Summary of Known Cultural Resources

The Cultural Records Office in Laramie provided information on the previous work conducted in

the Little Monument Project Area and previously recorded sites located in the project area. Records at Western Archaeological Services (WAS) were consulted for previous work in the project area. Consultation with the Archaeology Specialist of the RSFO of the BLM was conducted. There have been 18 projects conducted in the project area resulting in the recordation of 7 sites. These projects include 16 Class III block and linear surveys (including 1 seismograph survey) and 1 pipeline monitor. Limited amounts of field work have resulted in the documentation of cultural resources through survey, testing, examination of ethnographic records, and historic record research. No excavations have been conducted in the LMPA and no radiocarbon analysis has been conducted on cultural resources in the project area.

Table 3-13. Historic chronology.

Phase	Age A.D.
Protohistoric	1720 - 1800
Early Historic	1800 - 1842
Pre-Territorial	1842 - 1868
Territorial	1868 - 1890
Expansion	1890 - 1920
Depression	1920 - 1939
Modern	1939 - Present

Massey (1989)

The project area encompasses approximately six square miles or 3,857 acres. The entire project area falls under both surface and mineral jurisdiction of the federal government.

Approximately 240 acres (block) or ca. 6.8% of the project area have been inventoried for cultural resources. There are no acreage calculations for the linear projects.

The overall site density within the project area cannot be accurately calculated due to the paucity of projects conducted within the project area. Four sites have been recorded in Section 28 (48SW5135, 48SW5136, 48SW10919, and 48SW12064), one site (48SW6924) has been recorded in Section 21, and one site (48SW5134) has been recorded in Section 27. The Yellow Point Landscape (48SW10923) has been identified in all sections within the project area.

Site types

Seven sites have been recorded in the project area including six prehistoric open camp sites and one lithic landscape. No historic sites have been recorded in the project area. None of the sites in the project area are eligible to the NRHP.

Prehistoric sites

Prehistoric camps consist of sites that contain evidence of a broad range of activities including

subsistence-related activities. They may contain formal features, lithic debris, chipped stone tools, evidence of milling/vegetable processing activities including ground stone, and pottery. Single as well as multiple occupations are represented. Six of the seven previously recorded sites have been classified as open camps.

Lithic debris scatters consist of sites containing lithic debitage or stone tools. The sites are described as representing short-term activities. No lithic scatters have been identified in the project area.

Quarries are sites where lithic raw material was obtained and initially processed. Primary and secondary lithic procurement areas are geologic locations where chert and quartzite cobbles have been redeposited. No quarries have been identified in the project area.

Lithic landscapes are secondary lithic procurement deposits recommended not eligible for inclusion on the National Register. The artifacts from the sites cannot be associated with a specific cultural group or tradition nor can they be temporally associated. The Yellow Point Lithic Landscape (48SW10923) has been identified in the project area.

Human burials, rock alignments, and rock art have been identified as sensitive or sacred to Native Americans. Although human burials, rock alignments, or rock art have not been documented in the project area, it is important to be cognizant of the possibility of such resources.

Pottery/ceramics are relatively rare and no sites containing pottery have been identified in the project area. Pottery is usually associated with the Uinta phase of the Late Prehistoric period. Many times only a few fragmentary shards are found on a site's surface.

Consultation with appropriate Native American tribes pertaining to areas of concern for traditional, cultural, and religious purposes will occur in accordance with the American Indian Religious Freedom Act and BLM Manual 8160-1 Handbook. Native American consultation will occur within the context of specific development proposals, but will also be an ongoing process between BLM and affected Indian tribes and traditional cultural leaders (USDI-BLM 1997).

Historic sites

The Sublette Cutoff (48LN225) variant of the Oregon Trail is located slightly over one mile north and 2.5 miles west of the project area. The entire six sections in question are covered under the Blue Forest MOA. This MOA between the BLM and the SHPO establishes an area within which the setting of the Sublette and Kinney cutoffs is determined as being non-contributing due to extensive existing gas development.

No historic sites have been noted in the project area and no corrals, ranches, or local roads are shown on the 1892 GLO maps. Several water wells are noted on various maps of the general area but none in the project area.

Summary

Prehistoric subsistence and settlement patterns reflect a hunter-gatherer lifeway. Research into the subsistence and settlement patterns used during the Archaic period indicates summer occupations in the mountains, winter occupations in the foothills, and spring and fall movements utilizing all available zones (Creasman and Thompson 1997). Subsistence patterns in the Archaic period and the Late Prehistoric period are similar in that they are based on seasonal

movement throughout the basins and foothills in response to the availability of floral and faunal resources (Creasman and Thompson 1988). A wide diet breadth is evident in extensive procurement and processing of small mammals. By 450 YBP (Shimkin 1986), or possibly earlier (Bettinger and Baumhoff 1982), Numic-speaking Shoshonean groups occupied the Wyoming Basin and continued to reside there until Euro-American expansion relegated them to reservations beginning in 1868.

Few prehistoric sites have been recorded in the project area mainly due to the paucity of projects conducted in the area. Due to the proximity of the Green River to the project area, it is likely that more prehistoric sites will be located as development increases. In the Green River Basin, certain topographic settings, such as eolian deposits (sand dunes, sand shadows, and sand sheets), alluvial deposits along major drainages, and colluvial deposits along lower slopes of ridges, have higher archaeological sensitivity and should be attentively addressed.

The Sublette Cutoff of the Oregon Trail is north of the LMPA, but as noted above, it is non-contributing. No other historic sites have been noted in the project area and no corrals, ranches, or local roads are shown on the 1892 GLO maps. Several water wells are noted on various maps of the general area but none in the project area.

3.12 SOCIOECONOMICS

3.12.1 Introduction

Area socioeconomic conditions potentially affected by the Proposed Action and No Action Alternative include the local economy (primarily employment and earnings in the oil and gas industry and other sectors of the economy), population, housing, emergency response services, and local, state and federal tax revenues.

The LMPA is located entirely within Sweetwater County and is situated in an area of southwest Wyoming that also includes northeastern Lincoln County and southwestern Sublette County, an area of substantial existing oil and gas development. Rock Springs has emerged as a regional oil and gas service center and numerous other oil and gas service firms and suppliers are located in the Sweetwater County communities of Green River and the Farson/Eden area, the Lincoln County communities of Kemmerer, Diamondville and La Barge, and the Sublette County communities of Big Piney and Marbleton.

These communities would provide labor, services and supplies for the Little Monument project, and would also house and provide services to temporary workers coming into the area to work on the project. Therefore, the primary area of analysis for potential socioeconomic impacts is Sweetwater County, although oil and gas activity, temporary housing and emergency response capabilities will be discussed for Lincoln and Sublette counties and nearby communities.

3.12.2 Economic Conditions

An area's economic base is comprised of activities which bring money into the local economy from other areas of the state, nation and world. Sweetwater, Lincoln and Sublette counties all have natural resource-based economies. Basic sectors common to all counties include oil and gas production and processing, agriculture, tourism and recreation and state and federal government. The Sweetwater and Lincoln county economies are also based on coal mining,

electric power generation and transportation (primarily the Union Pacific railroad). Trona mining, the manufacturing of soda ash and related products and fertilizer manufacturing also add to the Sweetwater County economic base.

Employment and earnings are addressed for Sweetwater County because that is where the direct employment associated with the Little Monument project would occur. However, employees would be drawn temporarily from nearby communities and from outside the region and secondary employment effects would occur throughout southwest Wyoming.

3.12.2.2 Employment, Unemployment and Labor Force

Sweetwater County total full and part-time employment grew from the 1990 level of 22,856 jobs to a 2000 level of 24,436, growing by about seven percent or 1,580 jobs. There was some volatility during the period, however. In 1994 total employment peaked at 25,177 jobs. (WDAI 2002a). These employment statistics, compiled by the US Bureau of Economic Analysis, represent full and part-time jobs located within the county.

3.12.2.3 Earnings

Sweetwater County earnings by place of work increased from $633 million in 1990 to $881 million in 2002, a 39 percent increase over the decade (WDAI 2002b). This increase compares to a 56 percent increase in earnings for the State of Wyoming during this period. However, when adjusted for inflation, Sweetwater County earnings increased by about 6 percent during this period.

3.12.2.4 Recent Oil and Gas Activity

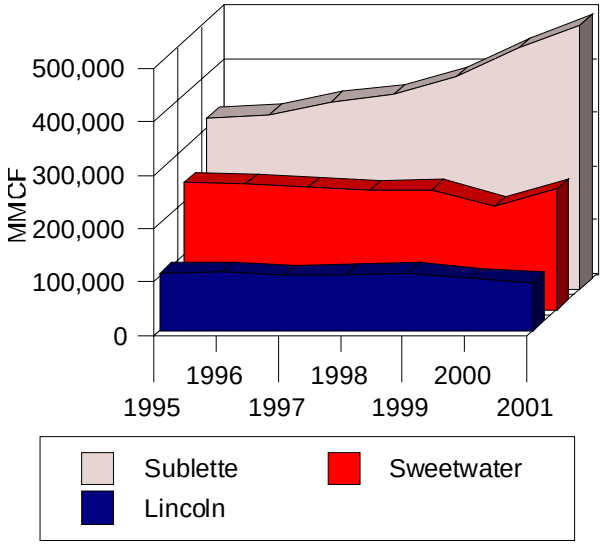
Production and approved APD's are two measures of oil and gas activity. As shown in Figure 3-8, annual natural gas production in Sweetwater and Lincoln counties has decreased over the six-year period, although Sweetwater County production has recently begun to increase. Production in Sublette County has been increasing fairly constantly throughout the period.

Together, these three counties accounted for just over half of Wyoming's total natural gas production in 2001 (WOGCC 1995-2001).

Approved APD's reflect both current and potential future oil and gas activity. Increased drilling may result in increased production if drilling efforts are successful and commodity prices increase or stabilize at economic levels. In the three counties, approved APD's have increased substantially in recent years (see Figure 3-9). In 2001, a total of 1,056 APD's were approved for the three-county area, including 534 in Sweetwater County, 435 in Sublette County and 87 in Lincoln County. APD's in Sweetwater and Lincoln counties decreased slightly duiring 2002 while APD's in Sublette County increased slightly. Note that 2002 statistics reflect applications rather than approved applications as in other years.

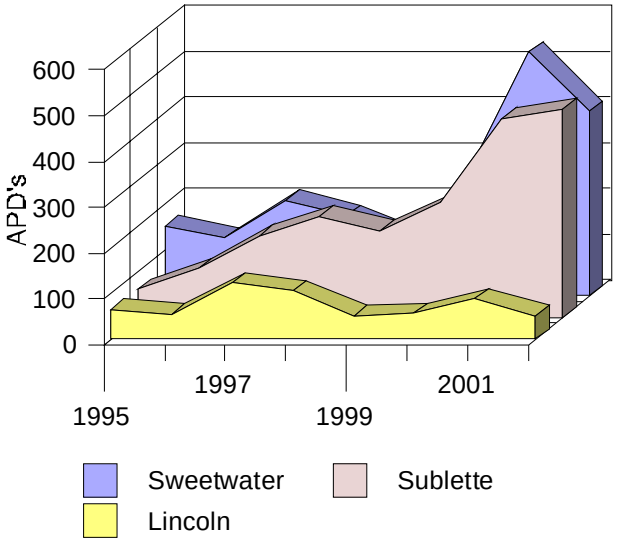
In 1995, there were a total of 3,640 producing wells (oil and gas) in the three-county area. By 2001, that number had increased to 5,414, a 49 percent increase over the 6-year period. The relatively high levels of natural gas exploration, drilling and production which have occurred in southwest Wyoming in recent years has sustained an active natural gas service industry (Robbins 2003). Additionally, natural gas development in the region is served by contractors operating out of Casper, Rawlins, Evanston and Riverton.

Figure 3-8. Natural Gas Production for Sweetwater, Lincoln and Sublette Counties: 1995-2001.



Source: WOGCC 1995-2001

Figure 3-9. Approved Sweetwater County APD's: 1995-2001.



Source: WOGCC 1995-2001

3.12.2.5 Other Economic Activities in the Vicinity of the Project Area

In addition to oil and gas exploration and production, other economic activities occurring in and

near the LMPA include grazing (Section 3.6) and low-intensity dispersed recreation (Section 3.9), (Deakins 2003).

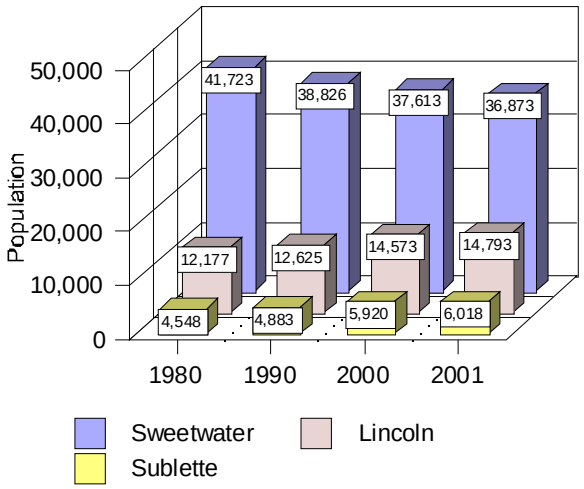
3.12.3 Population Conditions

Population levels in Sweetwater County have been volatile over the past 20 years. Sweetwater County population in 2000 was almost 10 percent lower than its 1980 level of 41,723 (Figure 3-10). It is estimated that Sweetwater County population continued to fall in 2001, losing an additional 2 percent of population (WDAI 2002c).

Although Lincoln and Sublette counties have grown in recent years, virtually every community near the LMPA lost population between 1990 and 2000, with the exception of Marbleton (Table 3-14). Nearby Lincoln and Sublette County communities have begun to add population in recent years (WDAI 2002d)

The most recent population forecasts available from the Wyoming Division of Economic analysis projects that population levels in Sweetwater County will decrease 6 percent by 2010, to 35,399. Lincoln and Sublette county communities near the LMPA are projected to lose population after slight increases in 2001, except Marbleton, which is projected to grow modestly throughout the decade (WDAI 2002d).

Figure 3-10. Sweetwater County Population: 1980, 1990, 2000 and 2001.



Source: WDAI 2002c

3.12.4 Housing

The nature of natural gas drilling and field development activities (relatively short duration tasks performed primarily by contractors) results in demand for temporary housing resources such as motel rooms and mobile home and recreational vehicle (RV) spaces near the project area.

There are a substantial number of temporary housing resources (motels and RV parks) available in Rock Springs including 15 motels with over 1,100 rooms and 30 mobile home parks with over 1,900 pads (PIC 1997).

Temporary housing resources in the Kemmerer/Diamondville area are in good supply. Recent workforce reductions have caused a number of rental units to be placed on the market.

Table 3-14. Population 1990 - 2001: Counties and Communities Near the LMPA.

	1990	1995	2000	2001
Sweetwater	38,823	40,635	37,613	36,873
Rock Springs	19,050	19,687	18,708	18,340
Green River	12,711	12,778	11,808	11,576
Lincoln County	12,625	14,073	14,573	14,793
Kemmerer	3,020	2,963	2,651	2,691
Diamondville	864	827	716	727
La Barge	493	483	431	438
Sublette County	4,843	5,515	5,920	6,018
Big Piney	454	449	408	415
Marbleton	634	696	720	732

Source WDAI 2002d

Additionally, there are six motels with a total of over 200 rooms in the area, and two recreational vehicle (RV) parks with a total of almost 100 units (Picerno 2001).

Temporary housing resources in the Big Piney/Marbleton area include two motels with a total of 45 rooms in Marbleton and two motels with a total of 36 rooms in Big Piney. Additionally there are mobile home parks and campgrounds with RV spaces in both towns.

3.12.5 Community Facilities, Law Enforcement and Emergency Management Services

Law enforcement in the area surrounding the LMPA is provided by the Sweetwater County Sheriff's Department. No routine patrols are provided in the area, rather deputies respond on an as needed basis (Scofield 2003).

Emergency management in Sweetwater County is coordinated by the Sweetwater County Emergency Management Agency (SCEMA), which operates under Federal Emergency Management Agency (FEMA) and Environmental Protection Agency (EPA) guidelines. SCEMA is the agency designated by the Sweetwater County Commissioners to analyze potential hazards, assess emergency response capabilities, plan for and respond to potential events and mitigate the effects of emergencies or disasters. SCEMA coordinates with response agencies, industry, elected officials and volunteer agencies to accomplish its mission of limiting injuries, loss of life and damage to property.

The portion of Sweetwater County that includes the LMPA is served by emergency response organizations (fire suppression, emergency medical and ambulance) located in the Eden/Farson area and the Town of Granger, with support from agencies in Green River and Rock Springs. Sweetwater County also has mutual aide agreements with emergency response agencies in Lincoln and Sublette counties, and emergency response agencies in Kemmerer and the Big Piney Marbleton area are likely to respond to accidents and emergencies if they are the closest agencies. Routine injuries may be treated at the medical center in Kemmerer, the Marbleton/Big Piney Medical Clinic, or at Memorial Hospital in Rock Springs. Cases requiring specialized treatment are transported to Salt Lake City by air ambulance services dispatched from Salt Lake City (Valentine 2003).

3.12.6 Local, State and Federal Government Fiscal Conditions

Fiscal conditions most likely to be affected by the Proposed Action and alternatives include the following:

- Sweetwater County, school and special district ad valorem property tax revenues;
- State, county and municipal sales and use tax revenues;
- State severance tax revenues; and
- Federal mineral royalties.

3.12.6.1 Ad Valorem Property Tax Revenues

Oil and gas companies pay ad valorem property taxes on production and facilities, with certain exemptions.

In Sweetwater County, fiscal year (FY) 2002 assessed valuation was over $1.4 billion, 0.2 percent less than the previous year. 2002 property tax revenues were $93.2 million, about 0.7 percent lower than 2001. Natural gas is assessed on the previous year's production. FY 2002 assessed valuation from 2001 natural gas production totaled $577.6 million or about 41 percent of total assessed valuation (WTPA 2002). FY 2002 mill levies within the unincorporated portion of Sweetwater County which contains the LMPA total 62.558 mills, including 43.5 mills for schools, a 12 mill county levy, 0.266 for weed and pest control, a 5 mill community college levy, 0.571 mills for fire protection, 0.931 mills for solid waste and 0.29 mills for the Eden/Farson cemetery.

3.12.6.2 Sales and Use Tax

Wyoming has a statewide four percent sales and use tax. Sweetwater County collects an additional one percent general-purpose local-option sales and use tax and a 0.5 percent specific purpose local-option tax, dedicated to construction of a new county jail. FY 2002 sales and use tax collections in Sweetwater County totaled about $59.56 million.

About 28 percent (less administrative costs) of the statewide four percent sales and use tax collections and all of the general purpose local option collections (also less administrative costs) are distributed to the county and its incorporated municipalities according to a population-based formula.

3.12.6.3 Wyoming Severance Taxes

The State of Wyoming collects a six percent severance tax on oil and natural gas. Severance tax revenues are distributed to the Wyoming Mineral Trust Fund, General Fund, Water Development Fund, Highway Fund, Budget Reserve Account, and to counties and incorporated cities and towns. In FY 2002, severance tax distributions totaled $299 million (CREG 2003a). Of the total, about 43 percent was attributable to severance taxes on natural gas.

3.12.6.4 Federal Mineral Royalties

The federal government collects a 12.5 percent royalty on oil and natural gas extracted from federal lands. Fifty percent of those royalties are returned to the state where the production occurred. In Wyoming, the state's share is distributed to a variety of accounts, including the University, the School Foundation fund, the Highway fund, the Legislative Royalty Impact Account, and cities, towns and counties. In FY 2002, a total of $348.6 million in federal mineral royalty funds were distributed to Wyoming entities (CREG 2003b).

3.13 TRANSPORTATION

The regional transportation system serving the LMPA includes an established system of interstate and state highways and county roads. Local traffic on federal land is also served by BLM roads and operator-maintained oil and gas field roads (Figure 3-11).

3.13.1 Highway Access to the Project Area

Highway access to the project area from Rock Springs and Green River is provided by Wyoming State Highway 372 (WYO 372), a two-lane, paved secondary highway which travels 38 miles northwest from I-80 to Fontenelle and another 11 miles west to its intersection with US 189 about 24 miles northeast of Kemmerer. Refer to Figure 3-11 for a road map of the area.

Access to the Project area from Kemmerer/Diamondville is provided by US 189 and WYO 372. Access from Big Piney/Marbleton is also provided by US 189, a paved, two-lane, primary highway, connecting US Interstate 80 on the south with Hoback Junction to the north, passing through Diamondville, Kemmerer, La Barge, Big Piney, Marbleton and Daniel.

Recent traffic volumes on Wyoming federal and state highways are listed in Table 3-15. The Wyoming Department of Transportation (WYDOT) assigns levels of service to highways in the state system. Levels of service (A through F) are assigned based on qualitative measures (speed, travel time, freedom to maneuver, traffic interruptions, comfort and convenience) that characterize operational conditions within traffic streams and the perceptions of those conditions by motorists. A represents the best travel conditions and F represents the worst. The federal and state highways proving access to the LMPA are currently rated A and A/B (Jones 2003).

3.13.2 County and BLM Road Access to the Project Area

From WYO 372, access to the LMPA is provided by a short (less than one mile) stretch of Lincoln County Road (LCR) 311, a two-lane gravel road, which is treated with dust suppressant (Dana 2003). Immediately after the Lincoln/Sweetwater County line is a bridge over the Green River on Sweetwater County Road (SCR) 8. The bridge is adequate for most loads, however,

oversize wide loads have damaged the guard rails in the past. On the east side of the bridge, SCR 8 connects with SCR 52, which travels about three miles north to connect with BLM Road 4202. BLM Road 4202 travels another six miles north to the southern boundary of the LMPA, traverses the project area along the western boundary for two miles and exits to the north. Some traffic coming from the Farson/Eden area uses SCR 49, which intersects with US 191 two miles north of Farson and proceeds west 32 miles to its intersection with SCR 52. Sweetwater County has a motor grader stationed in this area of the county to perform ongoing road maintenance activities (Gibbons 2003).

Traffic coming from La Barge and the Big Piney/Marbleton area sometimes uses LCR 318, which intersects with US 189 about five miles south of La Barge, and travels about a mile east and becomes BLM Road 4210 which intersects with BLM Road 4202 about 6 miles north of the LMPA. LCR 318 also has a one-lane bridge over the Green River, which has had its guard rails damaged by over-sized wide loads. A more common route for traffic coming from the north involves Lincoln County Road 313, which leaves US 189 and heads about 4 miles east toward Fontenelle Dam (the road across the dam is currently closed) and then heads south on LCR 316 for about three miles, and connects with LCR 311 at Fontenelle. This road receives intensive use and requires frequent maintenance including dust suppression. It is a priority of the Lincoln County Road and Bridge Department to pave this road when funds become available (Dana 2003).

3.13.3 Access within the Project Area

Existing access within the proposed LMPA is provided by BLM Road 4202 and an existing road network developed to service prior and ongoing drilling and production and ongoing livestock grazing activities. BLM Road 4202 and the gas field roads have been developed to accommodate gas field traffic and are maintained by the operator under the ROW grant.

Table 3-15. Traffic and Level of Service on Highways Providing Access to the Project Area.

Route	2001 AADT	2000 AADT	Level of Service
WYO 372 @ Milepost 38.409 (Sweetwater/Lincoln County Line)	270 (40) Trucks	300 (60) trucks	A
US 189 @ Milepost 61.240 (Fontenelle Townsite Road)	810 (90 trucks)	690 (90 trucks)	A/B
US 189 @ Milepost 83.960	940 (120 trucks)	890 (120 trucks)	A/B

Source: WYDOT 2001, Jones 2003

3.14 HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the LMPA include hazards associated with existing oil and gas operations ad exploration. Occupational hazards associated with oil and gas operations generally affect workers in the field and at oil and gas facilities. Two types

of workers are employed in oil and gas fields: oil and gas workers, who had a 1998 non-fatal accident rate of 4.0 per 100 workers, and special trade contractors, who had a non-fatal accident rate of 8.9 per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics 2000). These rates compare with an overall private industry average for all occupations of 6.2 per 100 workers.

There are also, existing risks associated with natural gas pipelines, although these risks are statistically very small. Nationwide, injuries associated with gas transmission pipelines averaged 14 per year from 1990 through 1996, fatalities averaged one per year and incidents such as ruptures averaged 79 per year (U.S. Department of Transportation 1998). Finally, there also within the LMPA are risks associated with vehicular travel on improved and unimproved county, BLM and oil and gas field roads; with firearms accidents during hunting season and by casual firearms use such as plinking and target shooting; and with natural events such as flash floods, landslides, earthquakes, and range fires, which can also result from human activities.

3.15 NOISE

Other than back ground noise (primarily wind), on-going natural gas production and maintenance operations and related traffic create most sound disturbances within and in the immediate vicinity of the LMPA. Aircraft overflights (generally at high altitudes) and localized vehicular traffic also create short-term, localized sound disturbances.

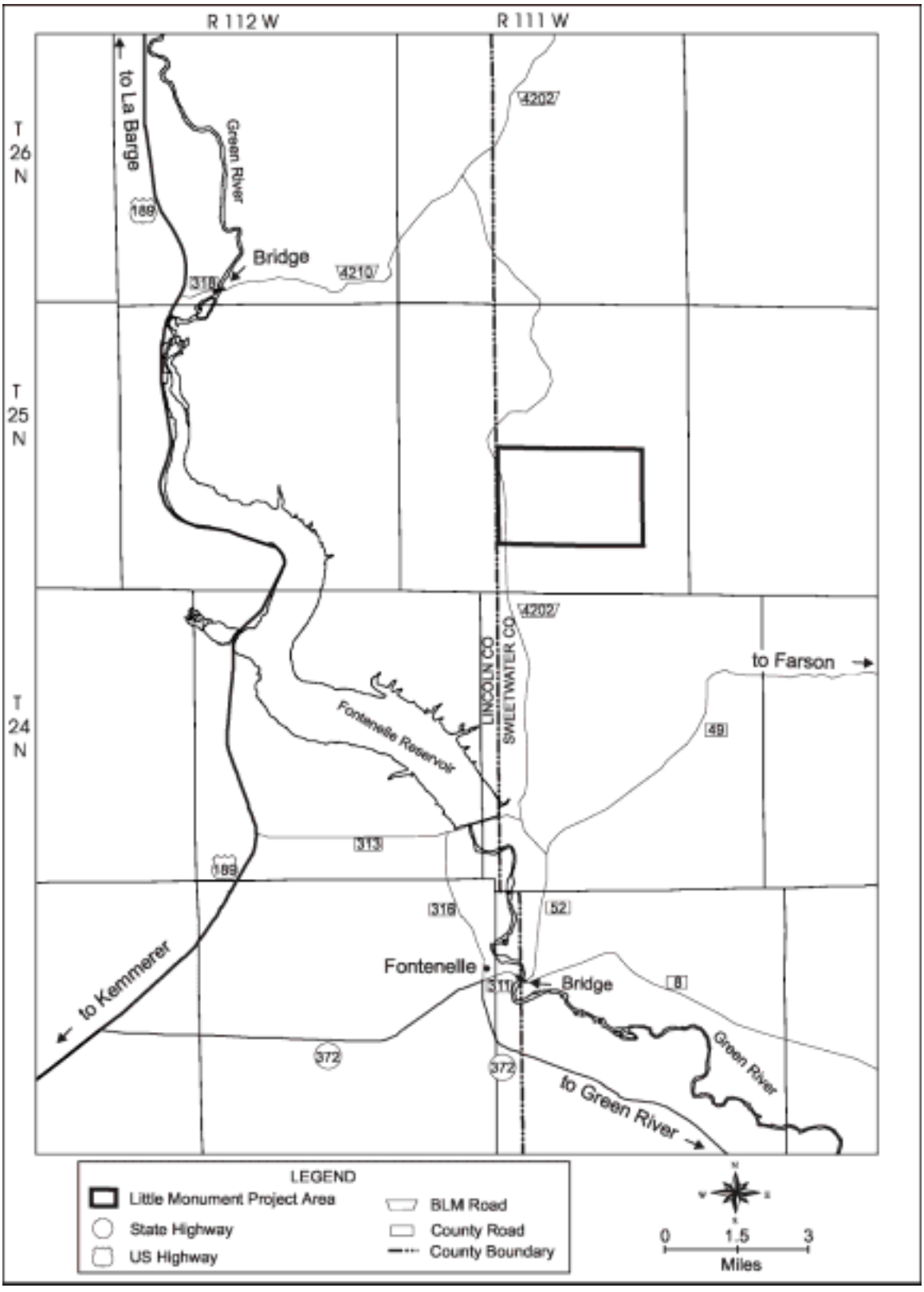


Figure 3-11. Highway and Road Access to the LMPA.