3 AFFECTED ENVIRONMENT

The ROIs affected by the proposed action presented in the ULP PEIS are described for each resource area evaluated (see Appendix D for additional discussion on the determination of the ROIs). This site-specific information will be used as the basis for evaluating the potential impacts from the alternatives discussed in Chapter 4.

Regions of Influence (ROIs) for the Various Resource Areas Evaluated in the ULP PEIS

Air Quality**:** Mostly within 31 mi (50 km) from the source(s) but up to several hundred miles, a minimal but cumulative contribution to air quality-related values (such as visibility and acid deposition)

Noise: Within 2–3 mi (3–5 km), from noise source(s) at best

Paleontological Resources: Lease tracts and any other areas on adjacent lands that could be affected by mining activities

Soil Resources: The lease tracts and any other areas on adjacent lands (e.g., unpaved access roads) that could be affected by mining activities

Water Resources: Montrose, Mesa, and San Miguel Counties, primarily on the lease tracts; also the Dolores River, San Miguel River, and their tributaries

Human Health: 50-mi (80-km) radius of the lease tracts

Land Use: The lease tracts and land within a 25-mi (40-km) radius of each lease tract, with an emphasis on specially designated public land areas

Ecological Resources: Montrose, Mesa, and San Miguel Counties, primarily on the lease tracts; the Dolores River, San Miguel River, and Colorado River (for threatened and endangered species evaluation only)

Socioeconomics: Montrose, Mesa, and San Miguel Counties

Environmental Justice: 50-mi (80-km) radius of the lease tracts

Transportation: 25-mi (40-km) radius from the boundary of the lease tracts

Cultural Resources: Lease tracts and any other areas on adjacent lands that could be affected by mining activities

Visual Resources: 25 mi (40 km) from the lease tracts

Waste Management: Surface mine plants on the lease tracts

3.1 AIR QUALITY

3.1.1 Climate

3.1.1.1 General Climate

Wide variations in elevation and topographic features within the area surrounding the ULP lease tracts have an impact on wind patterns, temperatures, and storm tracks in all seasons (NCDC 2011a). The area has a semi-arid, mid-continental climate characterized by abundant sunshine, low humidity, low precipitation, and cold, snowy winters. Strong, outgoing terrestrial radiation provides cool nights. In midwinter, air temperatures are often low, but strong solar radiation and dry air combine to provide generally pleasant conditions.

The local climate is strongly influenced by microclimatic features such as slope, aspect, and elevation. The prevailing wind direction aloft over the region is from the west or the southwest (the westerlies), as it is in most of the United States; however, complex terrains in western Colorado are responsible for deflecting these winds. Accordingly, wind patterns are sometimes dissimilar even over short distances.

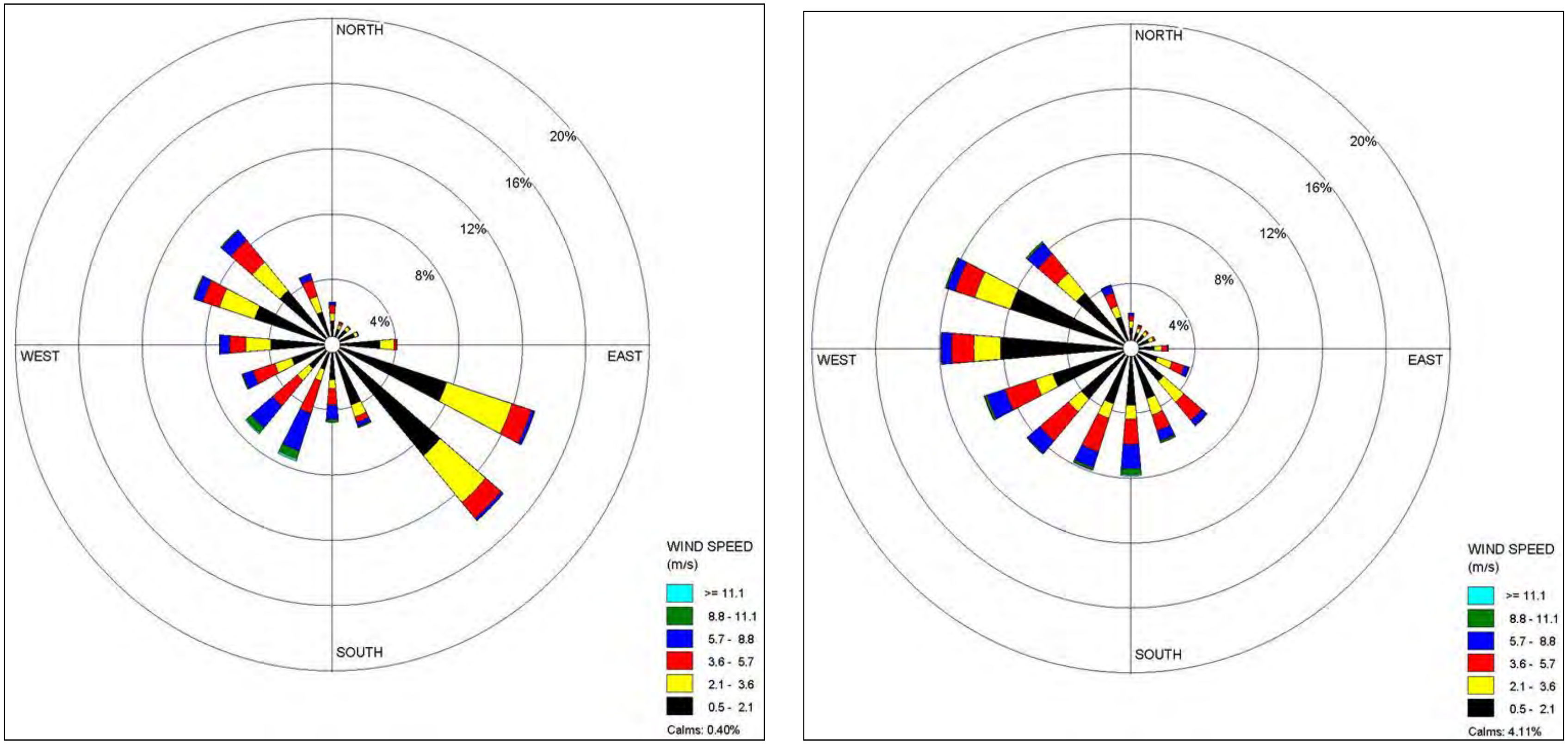
The ULP lease tracts are located in southwestern Mesa County and in western Montrose and San Miguel Counties in southwestern Colorado. The elevations of lease tracts range from 5,100 ft (1,500 m) to 8,000 ft (2,439 m) with an average elevation of about 6,401 ft (1,951 m). The area surrounding the ULP lease tracts is characterized by complex topography with valleys, canyons, and plateaus, so the climate varies considerably from place to place.

3.1.1.2 Wind

Wind roses (which graphically display the distribution of wind speed and direction) are presented here based on data available from weather stations in place for the proposed Piñon Ridge Mill, because they are located in the center of the ULP lease tracts scattered over a wide area. These stations are referred to as Site 1 (33-ft [10-m] level) and Site 2 (98-ft [30-m] level). Data for a 3-year period (April 2008–March 2011) are shown in Figure 3.1-1 (Rogers 2011). The proposed Piñon Ridge Mill site is located in the eastern Paradox Valley in western Montrose County, which is roughly at the center of ULP lease tracts. The Paradox Valley is aligned in a northwest–southeast direction. Winds are controlled in large part by the valley and ridge topography. At Site 1 (33-ft [10-m] level), winds blow more frequently from the northwest and southeast, reflecting the channeling of winds parallel to the valley axis. The annual average wind speed is about 6.3 mph (2.8 m/s). Average wind speeds are highest in spring at 7.9 mph (3.5 m/s) and lowest in winter at 4.6 mph (2.1 m/s). Prevailing wind directions are from the southeast (about 14% of the time) and the east–southeast (about 14% of the time). Secondary prevalent wind directions are from the northwest and west-northwest about 18% of the time combined. Thus, about half of the time, upslope and downslope winds along the valley axis prevail. However, effects of prevailing westerlies aloft are relatively minor at the surface. Northwesterly upslope winds blow more frequently during daytime, while southeasterly downslope winds (also called drainage winds) prevail at night.

Wind rose at Site 2 (98-ft [30-m] level) of the proposed Piñon Ridge Mill site, which is located about 1.3 mi (2.1 km) south–southeast of Site 1 on the same valley floor but closer to the valley wall, is provided in Figure 3.1-1(b). Wind patterns are somewhat different from those at Site 1 (33-ft [10-m]) level. Daytime upslope winds observed are like those at Site 1, while nighttime downslope winds are relatively weak. Typically, downslope winds are shallower than upslope winds, with little or no turbulence because of the stable temperature structure of the air. Throughout the year, westerly or southwesterly winds prevail at Site 2, especially during nighttime hours, suggesting it is more affected by regional winds than by local flows. Average wind speed at Site 2 is about 5.9 mph (2.6 m/s). As it is at Site 1, wind speed at Site 2 is highest in spring and lowest in winter. Prevailing wind direction at Site 2 is from the west–northwest (about 12% of the time) and secondarily is from the west (about 12% of the time). Winds that range from the southeast clockwise to northwest sectors, which is the lower-left half of the valley axis, account for more than three-fourths of the time.

Typically, wind speeds at higher elevations are faster than those at lower elevations because of surface friction. However, the reverse is observed at the proposed Piñon Ridge Mill. The upslope-downwind speed at Site 2 is lower than that at Site 1, which is located on the central



(a) (b)

FIGURE 3.1-1 Wind Roses at the Proposed Piñon Ridge Mill, Montrose County, Colorado, April 2008–March 2011: (a) Site 1, 33-ft (10-m) Level; and (b) Site 2, 98-ft (30-m) Level (Source: Rogers 2011)

valley floor, due to friction with the nearby valley wall at Site 2 and because local flows seem somewhat stronger than regional westerly winds.

Aside from the weather stations at the proposed Piñon Ridge Mill, there is also a BLM Remote Automated Weather Station at Nucla near the ULP lease tracts. Nucla station is located outside the southeastern edge of Paradox Valley, about 2 mi (3 km) south of Nucla and about 11 mi (18 km) east of the proposed Piñon Ridge Mill site. However, wind patterns are quite different from those at Piñon Ridge Mill. As shown in Figure 3.1-2, prevailing wind directions are from the east throughout the year due to predominant nighttime drainage winds from the San Miguel River valley to the east (DRI 2011). During daytime hours, effects of the San Miguel River valley, which runs in a northwest–southeast direction, parallel those of the Paradox Valley, and regional westerly winds are more prominent.

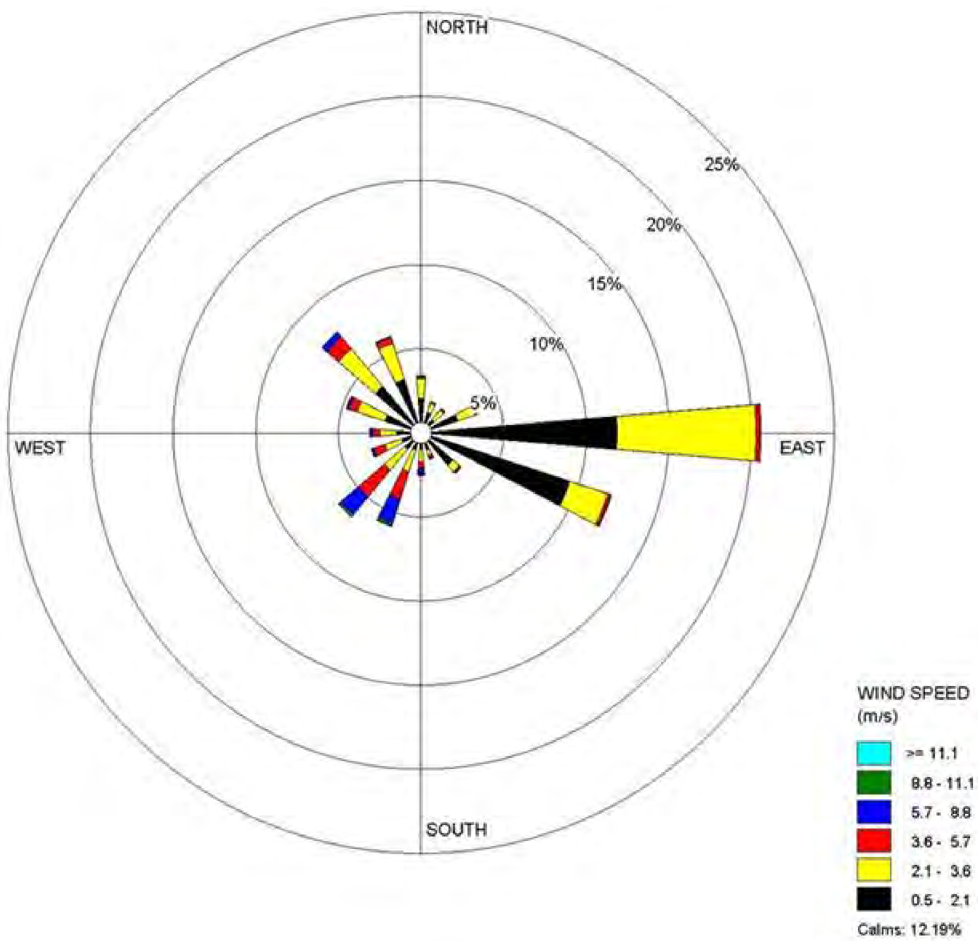


FIGURE 3.1-2 Wind Rose at 20-ft (6.1-m) Level at Nucla, Montrose County, Colorado, 2006–2010 (Source: DRI 2011)

3.1.1.3 Temperature

Temperatures in the region vary widely with elevation, latitude, season, and time of day. In western Colorado, topography plays a large role in determining the temperature of any specific location (NCDC 2011a). The ULP lease tracts sit at a higher elevation; thus, temperatures there are lower than at lower elevations of comparable latitude. Historical annual average temperatures measured at selected meteorological stations around the ULP lease tracts range from 45.3°F (7.4°C) in Northdale (about 10 mi [16 km] south of the southernmost ULP lease tract at an elevation of 6,680 ft [2,040 m]) to 53.9°F (12.2°C) in Gateway 1 SE (about 6 mi [10 km] northwest of the northernmost ULP lease tract at an elevation of 4,550 ft [1,390 m]), as presented in Table 3.1-1 (WRCC 2011a; DRI 2011). Typically, January is the coldest month, with nighttime lows ranging from 9.0 to 18.0°F (–12.8 to –7.8°C), and July is the warmest month, with daytime highs ranging from 86.5°F to 98.6°F (30.3 to 37.0°C). During the reporting period, the highest temperature of 110°F (43.3°C) was reached in June 1950 at Paradox 1 E and in July 1989 at Uravan, and the lowest of –42°F (–41.1°C) was reached in February 1933 at Northdale. Each year, about 17–76 days had a maximum temperature of ≥90°F (32.2°C), while about 132–205 days had minimum temperatures at or below freezing with subzero temperatures of about 3–18 days.

3.1.1.4 Precipitation

In Colorado, precipitation patterns are largely controlled by mountain ranges and elevation (NCDC 2011a). The interior, continental location, ringed by mountains on all sides, results in low precipitation year-round. Air masses crossing the region, which gather moisture over the Pacific Ocean and traverse several hundred miles of mountainous terrain, have precipitated a large percentage of inherent moisture, and thus the Colorado region receives little precipitation. For the reporting period, annual precipitation ranged from about 9.6 in. (24.3 cm) at Nucla to 16.0 in. (40.7 cm) at Paradox 1 W (WRCC 2011a). Precipitation is relatively evenly distributed throughout the year; however, isolated thunderstorms occur during the summer months. In general, precipitation is somewhat higher in fall months (about 30% of the annual total), and lower in winter months (about 22% of the annual total) around the ULP lease tracts. Snowfall varies by location (ranging on average from about 11 in. [28 cm] in Uravan to about 41 in. [104 cm] in Northdale), with the snowiest months being December through February. In general, snowfall tends to increase with increasing elevation, while precipitation has no clear relationship with respect to latitude and elevation in the area.

3.1.1.5 Severe Weather

Because mountain ranges surrounding ULP lease tracts block air masses from penetrating into the area, severe weather events, such as tornadoes, are a rarity, but floods, hail, high winds, winter storms, and wildfires do occur frequently (NCDC 2011b).

TABLE 3.1-1 Temperature and Precipitation Data Summaries at Selected Meteorological Stations around the ULP Lease Tracts, in Order of Meteorological Station Starting from North to South

		Temperature (°F)							Precipitation (in.)			
Station[c]	County	Average Monthly Minimum[a]	Average Monthly Maximum[a]	Annual Mean	Extreme Low	Extreme High	No. of Days with Max. Temp. ≥90°F	No. of Days with Min. Temp. ≤32°F (≤0°F)	Total Water Equiv.	Snowfall	Period of Record	Elev. (ft)
Gateway 1 SE	Mesa	18.0	93.2	53.9	–28	106	61.9	132.3 (3.1)	11.40	15.9	1947–2010	4,550
Paradox 1 W[b]	Montrose	17.4	90.1	50.9	–14	106	43.8	153.6 (3.1)	16.02	27.5	1977–1995	5,530
Paradox 1 E[b]	Montrose	12.0	92.5	49.7	–21	110	57.6	181.4 (9.9)	11.73	23.4	1948–1977	5,280
Uravan[c]	Montrose	15.5	95.6	53.2	–23	110	75.9	149.1 (3.8)	12.61	11.1	1960–2010	5,010
Nucla	Montrose	12.6	98.6	52.1	–10	104	NA[c]	NA	9.55	NA	1998–2011	5,860
Northdale	Dolores	9.0	86.5	45.3	–42	103	17.3	205.0 (17.8)	12.49	40.9	1930–2002	6,680

[a] "Average Monthly Minimum" denotes the monthly average of daily minimum values during the period of record, which normally occurs in January. "Average Monthly Maximum" denotes the monthly average of daily maximum values during the period of record, which normally occurs in July.

[b] Paradox 1 W and 1 E and Uravan are located at almost the same latitude.

[c] NA denotes not available.

Sources: DRI (2011); WRCC (2011a)

In the western valleys, localized flood-producing storms are more frequent. Occasionally, remnants of a decayed Pacific hurricane may dump heavy, widespread rains in Colorado (NCDC 2011a). Flash flooding from localized intense thunderstorms is more severe than flooding caused by snowmelt. Since 1994, 88 floods (with 61 flash floods) were reported in Mesa, Montrose, and San Miguel Counties combined (NCDC 2011b). Most floods were reported in towns along the river valleys, including Grand Junction, Gateway, and Mesa in Mesa County; Montrose, Naturita, Nucla, Uravan, and Bedrock in Montrose County; and Telluride and Placerville in eastern San Miguel County. These floods occurred mostly during summer months and caused some property and crop damage.

In these three counties, a total of 58 hail events were reported since 1962; some of these caused property and crop damage (NCDC 2011b). Hail events occurred mostly from May through September. Hail measuring 1.8 in. (4.4 cm) in diameter was reported in nine incidents.

Since 1962, 130 high wind events occurred in the three counties. Most were reported in Mesa County (NCDC 2011b). These high wind events occurred more frequently from May through September, with peak occurrence in June. A high wind with a maximum wind speed of 122 mph (54.5 m/s), which created blizzard conditions, was reported in January 1999 in Mesa County.

Winter snows are fairly frequent but are mostly light and quick to melt, except for the land around the southernmost DOE lease tracts near Edgar/The Spud Patch, which have substantial amounts of snow in some years that remain for much of the winter. Heavy snows in the high mountains are much more common. Since 1993, 410 snow and ice events were reported in Mesa County alone (NCDC 2011b). These caused some property damage and several deaths and injuries resulting from avalanches and traffic accidents.

Since 1999, 24 wildland and forest fires have been reported in the three counties, mostly during summer months, and they caused some property damage (NCDC 2011b). These fires were triggered by lightning in the area. Associated with ongoing global warming, large-wildfire frequency, fire duration, and fire season length have increased substantially in the western United States in recent decades and are projected to increase, especially in the Southwest (USGCRP 2009). This is due primarily to earlier spring snowmelt and higher spring and summer temperatures that reduce the moisture availability and dry out the vegetation that provides the fuel for fires.

Complex terrain typically disrupts the mesocyclones associated with tornado-producing thunderstorms; thus, tornadoes are less frequent and destructive in this region than they are in tornado alley (in the central United States) or Colorado’s eastern plains. Tornado frequencies per area in counties within the ULP lease tracts are less than one-tenth of those in the rest of the state. In the period April 1950 to August 2011, a total of 12 tornadoes (0.2 per year) were reported in the three counties (NCDC 2011b): 9 tornadoes in Mesa County; 3 tornadoes in Montrose County; and no tornados in San Miguel County. However, most tornadoes occurring in the area were relatively weak (eight F0 and four F1 on the Fujita tornado scale[1]), but one caused injury, and some minor property damage was reported. Most of these tornadoes occurred either in northern Mesa County around the I-70 area or in northeastern Montrose County. However, in October 2005, one F1 tornado hit Bedrock, which is located several miles from ULP lease tracts.

3.1.2 Existing Air Emissions

Mesa, Montrose, and San Miguel Counties have many small-scale industrial emission sources and two coal-fired power plants—Cameo station[2] in Palisade, Mesa County, and Nucla station in Nucla, Montrose County. The absolute amount of emissions, except for emissions from the two coal-fired power plants, is relatively low. The population is sparse, and the population centers and many of the industrial facilities are located along the handful of major roads such as I-70, US 50, and US 550. Several state highways exist around the ULP lease tracts, such as CO 90 and CO 141. Onroad mobile and industrial source emissions are concentrated along these routes.

Data on annual emissions of criteria pollutants and VOCs in Mesa, Montrose, and San Miguel Counties are presented in Table 3.1-2 for 2008 (CDPHE 2011a). Among the three counties, emissions are the highest in Mesa County and the lowest in San Miguel County. Emission data are categorized by type of source: point; area; onroad mobile; nonroad mobile; road dust; construction; biogenic; fires (forest/agricultural fires and structural fires); and so on. In 2008, onroad vehicle sources were primary contributors to total carbon monoxide (CO) emissions in three counties (about 38%), followed by forest/agricultural fires (about 21%). Onroad vehicle sources and point sources were primary and secondary contributors to total emissions of nitrogen oxides (NO_x) in three counties (about 31% and 22%, respectively). Point sources accounted for most of sulfur dioxide (SO_2) emissions in the three counties (over 94%), because of the two coal-fired power plants. Road dust was the primary contributor to PM_{10} emissions[3] (about 29%), with construction being a secondary contributor (about 27%). Biogenic sources (i.e., vegetation—including trees, plants, and crops—and soils) that release naturally

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[1] The Fujita tornado scale is classified with the fastest 0.40-km (0.25-mi) wind speeds: F0 (gale); F1 (moderate); and F2 (significant) through F5 (incredible) tornadoes are classified with wind speeds of 40 to 72 mph (19 to 32 m/s), 73 to 112 mph (33 to 50 m/s), and 113 to 157 mph up to 261 to 318 mph (51 to 70 m/s up to 117 to 142 m/s). The new Enhanced Fujita (EF) scale based on 3-second wind gusts was implemented on February 1, 2007. Similar to the original Fujita scale, the ratings are from EF0 to EF5. However, historical tornadoes are still categorized with the original Fujita scale, as are those in the NCDC's *Storm Events* database.

[2] The station has shut down at the end of 2010 and thus is no longer in service (see Section 4.7.2.10).

[3] Particulate matter, or PM, is dust, smoke, and other solid particles and liquid droplets in the air. The size of the particulate is important and is measured in micrometers (μm), which is 1 millionth of a meter (0.00004 inch). $PM_{2.5}$ is PM with an aerodynamic diameter that is less than or equal to 2.5 μm, and PM_{10} is PM with an aerodynamic diameter that is less than or equal to 10 μm. "Respirable" $PM_{2.5}$ is released into atmosphere through combustion-related sources, such as motor vehicles, power plants, and forest fires, and it can penetrate deep into the lungs. In contrast, sources of "inhalable" PM_{10} include crushing and grinding operations and fugitive dust from vehicles travelling on roads, and this pollutant can enter the respiratory system. These particles can cause or aggravate respiratory, heart, and lung diseases.

TABLE 3.1-2 Annual Emissions of Criteria Pollutants and Volatile Organic Compounds in Mesa, Montrose, and San Miguel Counties, Colorado, Encompassing the ULP Lease Tracts, 2008

	Annual Emissions (tons/yr)			
Pollutant[a]	Mesa County	Montrose County	San Miguel County	Three-County Total
CO	40,688	19,533	5,548	65,769
NO_x	9,048	3,665	1,093	13,806
VOCs	39,828	21,220	13,065	74,113
$PM_{2.5}$[b]	2,838	2,316	370	5,524
PM_{10}	8,050	5,823	1,504	15,377
SO_2	2,879	1,358	9	4,246

[a] Notation: CO = carbon monoxide; NO_X = nitrogen oxides; $PM_{2.5}$ = particulate matter with an aerodynamic diameter of ≤2.5 μm; PM_{10} = particulate matter with an aerodynamic diameter of ≤10 μm; SO_2 = sulfur dioxide; and VOCs = volatile organic compounds.

[b] $PM_{2.5}$ emissions were not included in the CDPHE's 2008 air pollutant emissions inventory database, so they were estimated by using available $PM_{2.5}/PM_{10}$ ratios (ARB 2011; Countess Environmental 2006).

Source: CDPHE (2011a)

occurring emissions accounted for a significant portion of the VOC emissions (about 83%). Forest/agricultural fires were the primary contributor (about 31%) to total $PM_{2.5}$ emissions of three counties, followed by point sources (about 21%).

Most of the Paradox Valley is utilized for open ranching, but some agricultural sources exist near Bedrock, Paradox, and Nucla, Montrose County. There are several minor sources throughout the valley, including aggregate processing operations, concrete batch plants, and uranium/vanadium ore mining (Edge Environmental, Inc. 2009). These operations are primarily sources of PM but can also utilize processes and/or equipment that emit NO_X, SO_2, CO, and some hazardous air pollutants (HAPs). Tri-State Generation and Transmission Association, Inc., operates a 100-MW coal-fired power plant in Nucla, which receives its coal supply exclusively from a coal strip mine, New Horizon Mine, by tractor-trailer truck (Tri-State 2011). The mine is located about 5 mi (8 km) northwest of the plant. The mining activities and coal transportation are sources of PM, while the power plant is a primary source of SO_2, NO_X, PM, CO, and some HAPs.

In 2010, Colorado produced about 130 million metric tons of *gross*[4] carbon dioxide equivalent (CO_2e)[5] emissions (Strait et al. 2007). Gross GHG emissions in Colorado increased by about 50% from 1990 to 2010, an increase more rapid than that in the nation as a whole, which was attributable to Colorado's population growth. In 2010, consumption-based electricity use (37%), followed by transportation (24%), was the primary contributor to gross GHG emissions in Colorado. Electricity use from coal-fired power plants is the single largest contributor to GHG emissions in Colorado (about 31%). Fossil fuel use (in the residential, commercial, and industrial sectors) and fossil fuel industry accounted for about 18% and 9%, respectively, of total state emissions. Non-energy-related emissions from agriculture, industrial processes, and waste management accounted for the rest of the GHG emissions in Colorado. These gross emissions in Colorado equate to about 2% of total GHG emissions of 6,600 million metric tons of CO_2e in the United States during 2009 (EPA 2011a). Colorado's *net* emissions were about 100 million metric tons of CO_2e, considering carbon sinks from forestry land use and agricultural soils throughout the state.

Climate changes are primarily associated with human-induced emissions of heat-trapping gases, so-called GHGs. These emissions come mostly from the burning of fossil fuels (e.g., coal, oil, and natural gas), with considerable contributions from land use changes, such as deforestation or agricultural practices. GHGs include CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorine-containing halogenated substances—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These gases are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, and are thus capable of preventing long-wave thermal radiant energy emitted at the earth's surface from leaving earth's atmosphere. The net effect over time is a trapping of absorbed radiation and a tendency to warm the planet's surface and the boundary layer of the earth's atmosphere, and this constitutes the "greenhouse effect." Some GHGs (CO_2, CH_4, and N_2O) are both naturally occurring and the product of industrial activities, while fluorine-containing halogenated substances are man-made and are present in the atmosphere exclusively due to human activities. In 2009, CO_2 emissions account for about 83.0% of total U.S. GHG emissions on the CO_2e equivalent basis, followed by CH_4 (about 10.3%) and N_2O (about 4.5%), with fluorine-containing halogenated substances accounting for the rest (EPA 2011a).

[4] Excluding GHG emissions removed by agricultural soils and as a result of forestry and land use.

[5] This is a measure used to compare the emissions from various GHGs on the basis of their global warming potential, defined as the cumulative radiative forcing effect of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas, CO_2. For example, global warming potentials used for GHG emission calculations and reporting are 1 for CO_2, 21 for methane (CH_4), and 310 for nitrous oxide (N_2O) over a 100-year time horizon. For other GHGs, including sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs), global warming potentials are typically much higher. The CO_2e for a gas is derived by multiplying the mass of the gas by the associated global warming potential.

3.1.3 Existing Air Quality

Under the Clean Air Act (CAA) which was last amended in 1990, the EPA has set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment (EPA 2011b). NAAQS have been established for six criteria pollutants—CO, lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), PM (both $PM_{2.5}$ and PM_{10}), and sulfur dioxide (SO_2), as shown in Table 3.1-3. The CAA established two types of NAAQS: primary standards to protect public health including sensitive populations (e.g., asthmatics, children, and the elderly) and secondary standards to protect public welfare, including protection against degraded visibility and damage to animals, crops, vegetation, and buildings. Any individual state can have its own State Ambient Air Quality Standards (SAAQS), but SAAQS must be at least as stringent as the NAAQS. If a state has no standard that corresponds to one of the NAAQS or if the SAAQS are not as stringent as the NAAQS, then the NAAQS apply. Colorado has a more stringent standard than the NAAQS for 3-hour SO_2 (CDPHE 2011b), as shown in Table 3.1-3.

An area where a criteria pollutant concentration exceeds NAAQS levels is called a nonattainment area. Previous nonattainment areas where air quality has improved to meet the NAAQS are redesignated as maintenance areas and are subject to an air quality maintenance plan. States must have State Implementation Plans (SIPs) that demonstrate how nonattainment areas will meet the NAAQS and how the NAAQS will be maintained in maintenance areas.

Mesa, Montrose, and San Miguel Counties, which encompass the ULP lease tracts, are located administratively within the Grand Mesa Intrastate Air Quality Control Region (AQCR) (see 40 CFR 81.173), along with other west-central counties in Colorado. Mesa County is within Colorado State AQCR 11, while Montrose and San Miguel Counties are within Colorado State AQCR 10. Currently, Colorado State AQCRs 10 and 11 are designated as being in unclassifiable/attainment for all criteria pollutants (EPA 2011c). However, Telluride in San Miguel County, which is located about 58 mi (93 km) east of the southernmost ULP lease tract, has been designated as a moderate maintenance area for PM_{10} since 2001.

The western counties generally have smaller towns, usually located in fairly broad river valleys. Because of the relatively low population density, low level of industrial activities, and relatively low traffic volume in the area, the quantity of anthropogenic emissions is small, and ambient air quality is thus relatively good.

Except for PM_{10} data at the proposed Piñon Ridge Mill, there are no recent measurement data for criteria air pollutants around the ULP lease tracts. Currently, CO, O_3, $PM_{2.5}$, and PM_{10} data are collected around the Grand Junction area in Mesa County (CDPHE 2011c). In addition, PM_{10} data are collected in Telluride in San Miguel County, which is designated as a PM_{10} maintenance area. No monitoring stations are operating in Montrose County.

In addition to the standards, Table 3.1-3 presents background levels for criteria pollutants. The highest background concentration levels that are related to the NAAQS for CO, Pb, NO_2, annual $PM_{2.5}$, and SO_2 representative of the ULP lease tracts in the statewide

TABLE 3.1-3 National Ambient Air Quality Standards (NAAQS), Colorado State Ambient Air Quality Standards (SAAQS), and Background Concentration Levels Representative of the ULP Lease Tracts in Mesa, Montrose, and San Miguel Counties, Colorado[a]

		NAAQS[b]			Background Concentration Levels	
Pollutant	Averaging Time	Standard Value	Standard Type[c]	Colorado SAAQS	Value[d,e]	Location[f] (Year)
CO	1-hour	35 ppm	P	–[g]	7 ppm (20%)	Grand Junction, Mesa County (2008–2010)
	8-hour	9 ppm	P	–	2 ppm (22%)	Grand Junction, Mesa County (2008–2010)
Pb	Rolling 3-month	0.15 µg/m^3	P, S	–	0.037 µg/m^3 (25%)	Denver (2008–2010)
NO_2	1-hour	100 ppb	P	–	38 ppb (38%)	Durango, La Plata County (2008–2010)
	Annual	53 ppb	P, S	–	3 ppb (6%)	Durango, La Plata County (2006–2008)
O_3	8-hour	0.075 ppm	P, S	–	0.067 ppm (90%)	Palisade, Mesa County (2008–2010)
$PM_{2.5}$	24-hour	35 µg/m^3	P, S	–	34.3 µg/m^3 (98%)	Grand Junction, Mesa County (2008–2010)
	Annual	15 µg/m^3	P, S	–	9.2 µg/m^3 (62%)	Grand Junction, Mesa County (2008–2010)
PM_{10}	24-hour	150 µg/m^3	P, S	–	131 µg/m^3 (87%)	Grand Junction, Mesa County (2008–2010)
					89 µg/m^3 (59%)	Piñon Ridge Mill, Montrose County (April 2008–March 2010)
SO_2	1-hour	75 ppb	P	–	38 ppb (50%)	Denver (2008–2010)
	3-hour	0.5 ppm	S	700 µg/m^3 (0.267 ppm)	0.01 ppm (4%)	Denver (2006–2008)

[a] CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter with an aerodynamic diameter of ≤ 2.5 µm; PM_{10} = particulate matter with an aerodynamic diameter of ≤ 10 µm; SO_2 = sulfur dioxide; ppm = part(s) per million; ppb = part(s) per billion.

Footnotes continued on next page.

TABLE 3.1-3 (Cont.)

[b] Refer to 40 CFR Part 50 and EPA (2011b) for detailed information on attainment determination and the reference method for monitoring.

[c] P = primary standards, which set limits to protect public health, including the health of "sensitive" populations, such asthmatics, children, and the elderly. S = secondary standards, which set limits to protect welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

[d] Monitored concentrations are second-highest for 1-hour and 8-hour CO and 3-hour SO_2; the highest for 24-hour Pb (no rolling 3-month averages available at the time of this writing); 3-year average of 98th percentile of 1-hour NO_2 and 24-hour $PM_{2.5}$; highest annual mean over 3 years for annual NO_2; 3-year average of annual fourth-highest daily maximum 8-hour average for O_3; 3-year average of annual means for annual $PM_{2.5}$; fourth-highest over 3 years for PM_{10} for Grand Junction data but highest over 2 years for Piñon Ridge Mill data; and 3-year average of 99th percentile of 1-hour daily maximum for 1-hour SO_2.

[e] Values in parentheses are background concentration levels as a percentage of NAAQS or SAAQS (for 3-hour SO_2 only).

[f] For each pollutant, the location shown is the closest monitoring station from the ULP lease tracts. For Pb and SO_2, values for Denver are presented to show that even the highest monitored values in Colorado are still well below the standard and thus not a concern.

[g] A hyphen indicates that no standard exists.

Sources: CDPHE (2011b); EPA (2011b,d)

monitoring network were less than or equal to 62% of their respective standards, as shown in Table 3.1-3 (EPA 2011d). However, 8-hour O_3 and 24-hour $PM_{2.5}$ and PM_{10} concentrations were approaching or close to the applicable standard (maximum at about 98% for 24-hour $PM_{2.5}$).

In addition, the Energy Fuels Resources Corp. air monitoring program collected PM_{10} data for 24 hours every 6 days at Sites 1 and 2, which are collocated with 10-m (33-ft) and 30-m (98-ft) meteorological towers of the proposed Piñon Ridge Mill, respectively. The 24-hour average PM_{10} data collected at Sites 1 and 2 are presented as a function of time for the period of April 2008 through March 2010 in Figure 3.1-3 (Rogers 2011) and are also presented in Table 3.1-3. The monitored highest 24-hour PM_{10} concentration of 89 $\mu g/m^3$ at the proposed Piñon Ridge Mill was well below the NAAQS of 150 $\mu g/m^3$.

Climate changes are under way in the United States and globally, and they are projected to continue to grow substantially over next several decades unless intense, concerted measures are taken to reverse this trend (USGCRP 2009). Climate-related changes include rising temperature and sea level, increased frequency and intensity of extreme weathers (e.g., heavy downpours, floods, and droughts), earlier snowmelts and associated frequent wildfires, and reduced snow cover, glaciers, permafrost, and sea ice.

The Western States have heated up more than the world as a whole (Saunders et al. 2008). For the 2003–2007 period, the global climate has averaged 1°F (0.6°C) warmer than the

20th century average. For the same period, the 11 Western States averaged 1.7°F (0.9°C) and Colorado averaged 1.9°F (1.1°C) warmer than the 20th century average. In the arid/semi-arid West, global warming is already having serious consequences on the region's scarce water supplies, particularly the snow that makes up most of the region's precipitation and, when melted, provides 70% of its water. To date, decreases in snowpack, less snowfall, earlier snowmelt, more winter rain events, increased peak winter flows, and reduced summer flows have been documented.

As the effects of global climate change continue, it is very likely that, associated with northward migration of storm tracks (USGCRP 2009), desertification will intensify in the Southwestern States; thus, it will be more likely that more dust will be produced as vegetative cover decreases and as soils dry (Morman 2010). It is widely understood that impurities in snow, such as dust or soot, decrease snow albedo and enhance solar radiation absorption and melt rates. Dust may shorten snow cover duration by as much as a month (Painter et al. 2007). Earlier spring snowmelt along with higher spring/summer temperatures have broad implications with regard to water resources in Southwestern States that are already strapped for water, especially during the summer when peak demand is higher, and it leads to an increased the number of forest fires (USGCRP 2009). The problem of disturbed desert dust causing regional climate change and early snowmelt is discussed in numerous recent scientific articles. Neff et al. (2008) documented how the phenomenon of dust causing snowmelt was largely coincidental with increased settlement of the American West. The deposition of this disturbed desert dust on snow leads to early snow melt (Painter et al. 2007). In the Colorado River Basin, these effects are significant. Painter et al. (2010) estimated that the landing of disturbed desert soils traceable to settlement of the American West on mountain snowpack in the Upper Colorado River Basin has resulted in a net loss of approximately 5% of the annual flow of the Colorado River as measured at Lees Ferry, Arizona. It is likely that most dust on snowpack at high mountains around the ULP region is coming from nearby lands where soil-disturbing activity has made them susceptible to wind erosion and from the deserts of the Colorado Plateau along with prevailing westerlies; it is also coming from other Southwestern deserts to some extent. Activities such as exploration and development of energy resources, off-road vehicle use, agriculture, and grazing serve to destabilize soils, making them more susceptible to wind erosion (Belnap et al. 2009).

3.1.4 Regulatory Environment

3.1.4.1 Prevention of Significant Deterioration (PSD)

The Prevention of Significant Deterioration (PSD) regulations (see 40 CFR 52.21), which are designed to limit the growth of air pollution in clean areas, apply to a new major source or a modified existing major source within an attainment or unclassified area. PSD regulations limit increases in ambient concentrations above legally established baseline levels for selected criteria pollutants, as shown in Table 3.1-4. Incremental increases in PSD Class I areas, such as National Parks (NPs) or Wilderness Areas (WAs), are strictly limited, while those in

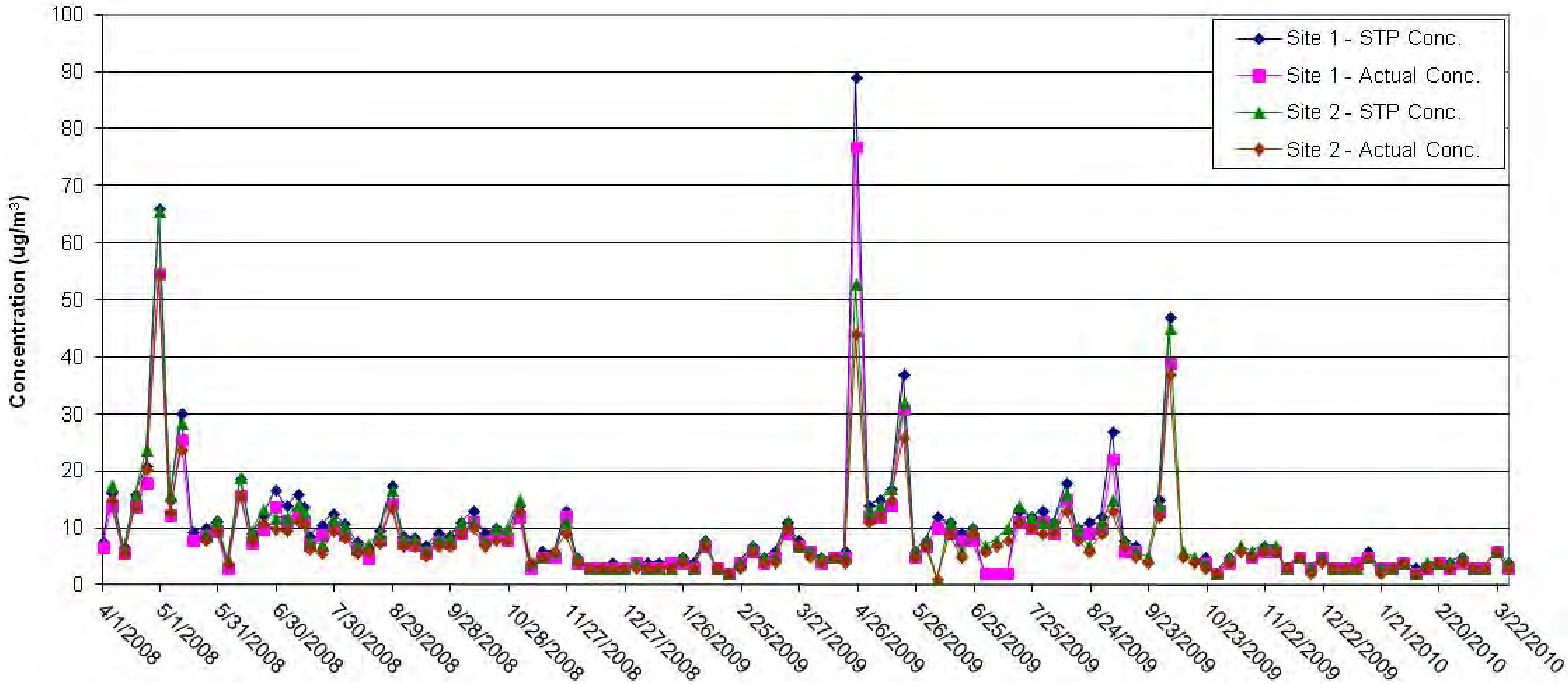

FIGURE 3.1-3 Monitored PM_{10} Concentrations at Sites 1 and 2 of the Proposed Piñon Ridge Mill, April 2008–March 2010 (Rogers 2011)

TABLE 3.1-4 Maximum Allowable PSD Increments for PSD Class I and Class II Areas

Pollutant	Averaging Time	PSD Increment ($\mu g/m^3$) Class I	Class II
NO_2	Annual	2.5	25
$PM_{2.5}$	24-hour	2	9
	Annual	1	4
PM_{10}	24-hour	8	30
	Annual	4	17
SO_2	3-hour	25	512
	24-hour	5	91
	Annual	2	20

Source: 40 CFR 52.21; 75 FR 64864

Class II areas (the rest of the country) allow for moderate growth in emission levels. Most of the area surrounding the ULP lease tracts is classified as PSD Class II. Major (large) new and modified stationary sources must meet the requirements for the area in which they are located and the areas they affect.

As a matter of policy, the EPA recommends that the permitting authority notify the Federal Land Managers (FLMs)[6] when a proposed PSD source would locate within 62 mi (100 km) of a Class I area for a determination of the potential impact on AQRVs, which are discussed in Section 3.1.4.4. There are several Class I areas around the ULP lease tracts, five of which are situated within 62 mi (100 km), as shown in Figure 3.1-4. The permit may still be issued even if the FLM determines that there may be an adverse impact on AQRVs. The nearest Class I area is the Arches NP in Utah (40 CFR 81.430), about 32 mi (51 km) west of the northernmost lease tract. The other four Class I areas within this range include Canyonlands NP in Utah, which is about 34 mi (55 km) west of the southernmost lease tract, and Mesa Verde NP, Black Canyon of the Gunnison WA, and Weminuche WA in Colorado (40 CFR 81.406); these WAs are located about 47 mi (76 km) south–southeast of the southernmost lease tract, 50 mi (81 km) east–northeast of the central lease tract, and 62 mi (100 km) east–southeast of the

[6] FLM is the Secretary of the department with authority over the Federal Class I areas (or the Secretary's designee). For DOI, the Secretary has designated the Assistant Secretary for Fish and Wildlife and Parks as the FLM, whereas the Secretary of Agriculture has delegated the FLM responsibilities to the Regional Forester and, in some cases, the Forest Supervisor.

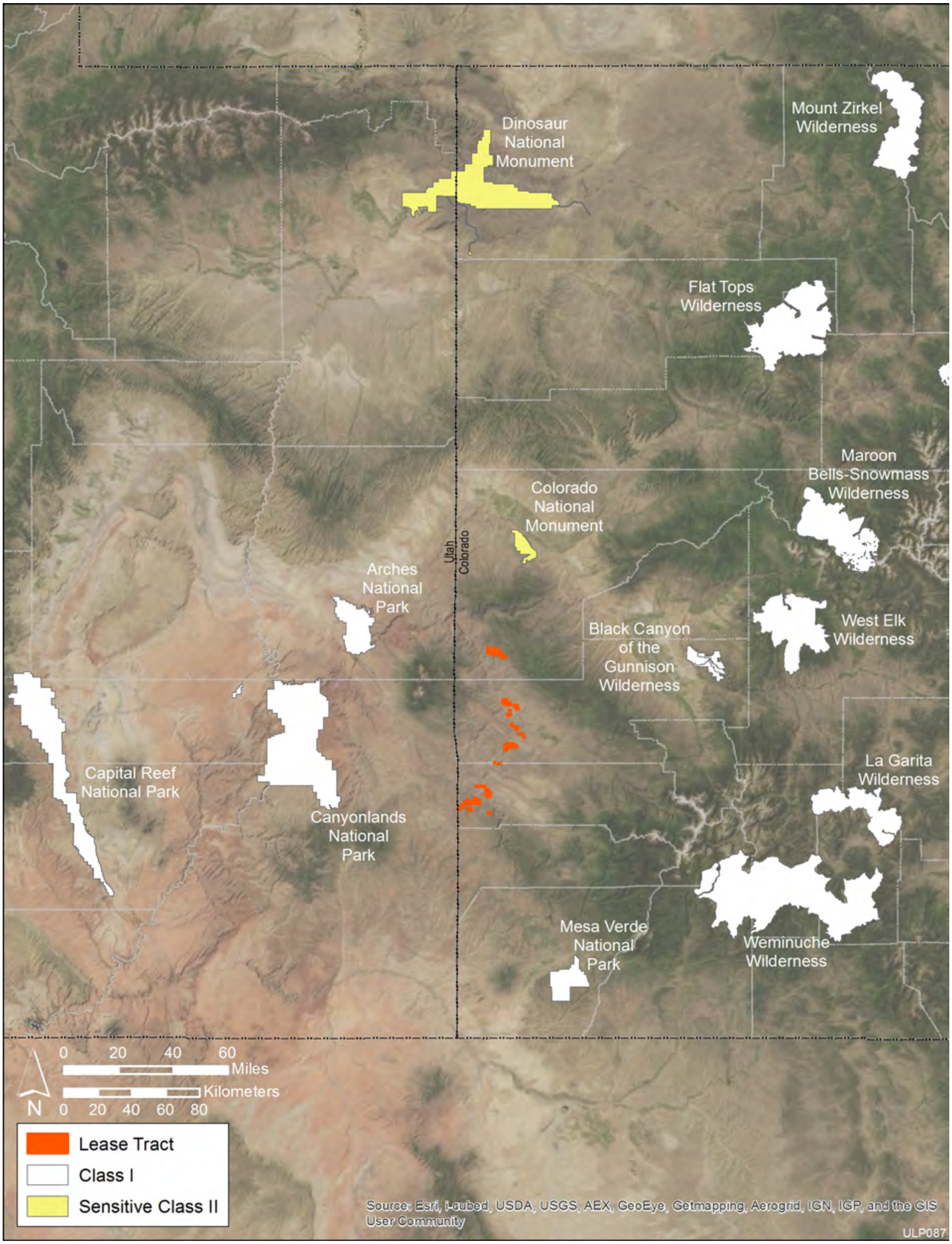

FIGURE 3.1-4 PSD Class I Areas and Colorado Sensitive Class II Areas around the ULP Lease Tracts

southernmost lease tract, respectively. There are two sensitive Class II areas that are regulated by CDPHE as Class I for SO_2: Colorado National Monument and Dinosaur National Monument, which are located about 25 mi (40 km) north–northeast and 111 mi (179 km) north of the northernmost ULP lease tracts, respectively. The ULP lease tracts are designated as a PSD Class II area by EPA and the State of Colorado.

3.1.4.2 Visibility Protection

Visibility was singled out for particular emphasis in the CAA Amendments of 1977. Visibility in a Class I area is protected under two sections of the Act. Section 165 provides for the PSD program (described above) for new sources. Section 169(A), for older sources, describes requirements for both reasonably attributable single sources and regional haze that address multiple sources. FLMs have a particular responsibility to protect visibility in Class I areas. Even sources located outside a Class I area may need to obtain a permit that ensures they have no adverse impact on visibility within the Class I area, and existing sources may need to retrofit controls. The EPA's 1999 Regional Haze Rule set goals of preventing future impairments and remedying existing impairments to visibility in Class I areas. States had to revise their SIPs to establish emission reduction strategies to meet a goal of natural conditions by 2064.

3.1.4.3 General Conformity

Federal departments and agencies are prohibited from taking actions in nonattainment and maintenance areas unless they first demonstrate that the actions would conform to the SIP as it applies to criteria pollutants. Transportation-related projects are subject to requirements for transportation conformity. General conformity requirements (40 CFR Parts 51 and 93, 75 FR 17254, dated April 5, 2010) apply to stationary sources. Conformity addresses only those criteria pollutants for which the area is in nonattainment or maintenance (e.g., VOCs and NO_x for O_3). If annual source emissions are below specified threshold levels, no conformity determination is required. If the emissions exceed the threshold, a conformity determination must be done to demonstrate how the action will conform to the SIP. The demonstration process involves public notification and response and may require extensive analysis.

3.1.4.4 Air Quality-Related Values

AQRVs are defined as valued resources that may be adversely affected by a change in air quality from air pollutant emissions, including visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource identified by the FLM for a particular area. Although the permit applicant should identify the potential impacts of the source on all applicable AQRVs of that area, an FLM may ask an applicant to address any or all of the areas of concern. The primary areas of concern to the FLMs are visibility impairment and effects of pollutant deposition on soils and surface waters (USFS et al. 2010).

Visibility is a measure of aesthetic value and the ability to enjoy scenic vistas, but it also can be an indicator of general air quality. Visibility degradation is caused by cumulative emissions of air pollutants from a myriad of sources scattered over a wide geographical area, such as combustion-related sources and fugitive sources. The primary cause of visibility degradation is the scattering and absorption of light by fine particles (such as sulfates, nitrates, organic carbon, light-absorbing soot, soil dust, and sea salt) with a secondary contribution provided by gases (such as nitrogen dioxide). In general, visibility conditions in the western United States are substantially better than those in the eastern United States, which has higher pollutant loads and humidity levels. Dust sources vary greatly spatially and temporally but play a more important role in visibility degradation in the arid parts of the western United States. Fugitive dust from wind erosion and anthropogenic activities, including agriculture, construction, grazing, mining, and vehicle traffic on paved and unpaved roads, would be a major concern in the arid desert environment. The typical visual range (defined as the farthest distance at which a large black object can be seen and recognized against the background sky) in most of the West is about 60 to 90 mi (97 to 145 km), while that in most of the eastern United States is about 15 to 30 mi (24 to 48 km) (EPA 2006).

Annual mean reconstructed light extinction coefficients (b_{ext}) and deciview (dv)[7] averaged over 2005–2008 are similar for Class I areas around the ULP lease tracts (Hand et al. 2011): b_{ext} of 20.18 Mm^{-1} and 6.66 dv for Canyonlands NP; b_{ext} of 21.34 Mm^{-1} and 7.07 dv for Mesa Verde NP; and b_{ext} of 20.34 Mm^{-1} and 6.66 dv for Weminuche WA. These values correspond to about 120–125 mi (193–201 km) in visual range.

Much progress has been made to control SO_2 and NO_2 emissions primarily from fossil fuel–fired power plants and onroad/offroad engine exhaust, but dry and wet depositions of sulfur and nitrogen compounds continue to be a problem in the United States. Acid deposition causes acidification of lakes and streams, which has direct impacts on aquatic habitats, and contributes to the damage of trees at high elevation and many sensitive forest soils. In particular, certain sensitive freshwater lakes and streams continue to lose acid-neutralizing capacity (ANC), defined as a measure of the ability for water or soil to neutralize added acids, and sensitive soils continue to be acidified (USFS et al. 2010). In particular, many alpine lakes in the western United States are low in ANC because of thin soils and slowly weathering bedrock. Thus, these alpine lakes are vulnerable to changes in water chemistry caused by acid deposition.

Average total (dry + wet) depositions of sulfur and nitrogen combined at Clean Air Status and Trends Network (CASTNET) stations around the ULP lease tracts are about 2.88 kg/ha/yr for Canyonlands NP; 3.11 kg/ha/yr for Gothic in Gunnison County, Colorado; and 3.82 kg/ha/yr for Mesa Verde NP (EPA 2012b). These deposition fluxes are much lower than those in the

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7 The extinction coefficient (b_{ext}) represents the ability of the atmosphere to scatter and absorb light primarily by particles and, to some extent, by gases, and has unit of inverse length (inverse megameters, Mm^{-1}). The b_{ext} is related to visual range and deciview (a haziness index designed to be linear with respect to human perception of visibility, analogous to the decibel scale in acoustics). A higher b_{ext} corresponds to a lower visual range and higher deciview values.

eastern United States. In general, nitrogen depositions are primary contributors to total depositions; in the eastern United States, sulfur depositions are more important.

3.2 ACOUSTIC ENVIRONMENT

3.2.1 Sound Fundamentals

Any pressure variation that the human ear can detect is considered "sound," and "noise" is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured with a logarithmic decibel (dB) scale.[8] To account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies, and most sensitive to sounds between 1,000 and 5,000 Hz),[9] A-weighting (denoted by dBA) (Acoustical Society of America 1983, 1985) is widely used. This scale has a good correlation to a human's subjective reaction to sound. Most noise standards, guidelines, and ordinances use the A-weighted scale.

To account for variations of sound with time, several sound descriptors are used. L_{90} is the sound level exceeded 90% of the time. It is called the residual sound level (or background level), and it is a fairly steady, lower sound level on which discrete single events are superimposed. The equivalent-continuous sound level (L_{eq}) is the level that, if it were continuous during a specific time period, would contain the same total energy as the actual time-varying sound. In addition, human responses to noise differ depending on the time of the day. People are more annoyed by noise during nighttime hours when there are lower background noise levels. The day-night average sound level (L_{dn}, or DNL) is the average over a 24-hour period, with the addition of 10 dB to sound levels from 10 p.m. to 7 a.m. to account for the greater sensitivity of most people to nighttime noise. The L_{dn} scale is widely used for community noise assessment and has been adopted by several Government agencies (e.g., Federal Aviation Administration, Department of Housing and Urban Development, and Nuclear Regulatory Commission). In general, a 3-dB change over an existing noise level is considered a barely discernible difference, and a 10-dB increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (NWCC 2002).

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[8] Scales for measuring most familiar quantities such as length, distance, and temperature are linear. Logarithmic scales, such as dB, compress the values of the measurements and are useful for measuring quantities like sound levels that can vary over a large range. For example, two linear measurements of 10 units and 1,000,000,000 units might correspond to values of 1 and 9, respectively, on a logarithmic scale. Logarithmic units also add differently than do linear units. For example, if one object is 6 ft long and a second is twice as long, the second object is 12 ft long. For sounds, however, if one sound level is 50 dB and a second is twice as loud, the second sound level will be 60 dB, not 100 (50 + 50) dB.

[9] The frequency is defined as the number of cycles per second, which is denoted by the unit of hertz (Hz). The normal hearing for a healthy young person ranges in frequency from about 20 to 20,000 Hz. The higher the frequency of the waveform, the higher the pitch of the sound heard.

3.2.2 Background Noise Levels

Background noise is defined as the noise from all sources other than the source of interest. The background noise level can vary considerably, depending on the location, season, and time of day. Background noise levels in a busy urban setting can be as high as 80 dBA during the day. In isolated outdoor locations with no wind, vegetation, animals, or running water, background noise may be under 10 dBA. Typical noise levels in rural settings are about 40 dBA during the day and 30 dBA during the night, which correspond to an L_{dn} of 40 dBA; in Wilderness Areas, typical noise levels are on the order of 20 dBA (Harris 1991).

State highways CO 90 and CO 141 run through or near the ULP lease tracts, and many county roads are scattered all over the ULP lease tracts. The nearest railroad runs as close as about 27 mi (43 km) from the northernmost ULP lease tracts. The nearest airport is Hopkins Field Airport in Nucla, about 7 mi (11 km) east of central ULP lease tracts. Other nearby public airports within a 50-mi (80-km) range include Grand Junction Regional Airport and Mack Mesa Airport in Mesa County, Montrose Regional Airport in Montrose County, Telluride Regional Airport in San Miguel County, and Monticello Airport in San Juan County, Utah . In addition, many private airports and heliports are scattered over the counties encompassing the ULP lease tracts. Most of Paradox Valley, which is located in the center of the ULP lease tracts, is utilized for open ranching, but some agricultural activities occur near Bedrock, Paradox, and Nucla in Montrose County. There are several minor noise sources throughout the valley, including aggregate processing operations, concrete batch plants, and uranium and vanadium ore mining (Edge Environmental, Inc. 2009). There is a 100-MW coal-fired power plant in Nucla, which receives coal from a nearby strip mine (New Horizon Mine) by tractor-trailer truck (Tri-State 2011). In addition, agricultural activities occur near Egnar in San Miguel County, south of the southernmost ULP lease tracts. Accordingly, in addition to natural sound sources (e.g., wind, rain, wildlife), noise sources around the ULP lease tracts include road traffic, aircraft flyovers, animal noise, agricultural activities, industrial activities, and nearby community activities and events. Other potential noise sources are recreational all-terrain vehicles being driven across the ULP lease tracts and ventilation shaft noise from underground mines. In summary, the area around the ULP lease tracts is remote, sparsely populated, and undeveloped; the overall character is considered mostly rural or undisturbed wilderness.

No sensitive receptors (e.g., hospitals, schools, or nursing homes) exist within a range of 3 mi (5 km) from the ULP lease tracts. Only 17 residences exist within 1 mi (1.6 km) of the 31 lease tracts; 7 of the 17 residences are adjacent to the 13 lease tracts. To date, no environmental noise survey has been conducted around the ULP lease tracts. It is likely that noise levels along the state highways and near agricultural/industrial activities would be relatively higher (about 50–60 dBA), while levels in areas far removed from manmade noise sources would be similar to wilderness background noise levels (below 30 dBA). On the basis of county population density data, L_{dn} noise level estimates around the ULP lease tracts would be about 38 dBA for Mesa County, 35 dBA for Montrose County, and 30 dBA for San Miguel County (Miller 2002). For comparison, rural and undeveloped areas typically have L_{dn} levels in a range of 33–47 dBA (Eldred 1982).

3.2.3 Noise Regulations

At the Federal level, the Noise Control Act of 1972 and subsequent amendments (Quiet Communities Act of 1978, 42 USC 4901–4918) delegate the authority to regulate noise to the states and direct Government agencies to comply with local noise regulations. EPA guidelines recommend L_{dn} of 55 dBA as sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas and farms (EPA 1974). For protection against hearing loss in the general population from nonimpulsive noise, the EPA recommends L_{eq} of 70 dBA or less over a 40-year period.

ULP activities would have to follow applicable Federal, state, or local guidelines and regulations on noise. Colorado has a noise statute with quantitative noise limits by zone and time of day, as shown in Table 3.2-1 (Colorado Revised Statutes, Title 25, “Health,” Article 12, “Noise Abatement,” Section 103, “Maximum Permissible Noise Levels”). However, Mesa, Montrose, and San Miguel Counties, which encompass the ULP lease tracts, do not have quantitative noise guidelines and regulations applicable to the ULP activities.

TABLE 3.2-1 Colorado Limits on Maximum Permissible Noise Levels

	Maximum Permissible Noise Levels (dBA)[a]	
Zone	7 a.m. to next 7 p.m.[b]	7 p.m. to next 7 a.m.
Residential	55	50
Commercial	60	55
Light industrial	70	65
Industrial	80	75

[a] At a distance of 25 ft or more from the property line. Periodic, impulsive, or shrill noises are considered a public nuisance at a level of 5 dBA less than the levels tabulated. Construction projects shall be subject to the maximum permissible noise levels specified for industrial zones for (1) the period within which construction is to be completed pursuant to any applicable construction permit issued by the proper authority or (2) if no time limitation is imposed, for a reasonable period of time for completion of the project.

[b] The tabulated noise levels may be exceeded by 10 dBA for a period not to exceed 15 minutes in any 1-hour period.

Source: Colorado Revised Statutes, Title 25, “Health,” Article 12, “Noise Abatement,” Section 103, “Maximum Permissible Noise Levels”

3.3 GEOLOGICAL SETTING AND SOIL RESOURCES

3.3.1 Geological Setting

3.3.1.1 Physiography

The lease tracts are located within the eastern part of the Canyon Lands section of the Colorado Plateau physiographic province in southwestern Colorado (Figure 3.3-1). The plateau is an extensive region generally characterized by nearly horizontal sedimentary formations covering an area of about 130,000 mi^2 (340,000 km^2) in the four corners region of Utah, Colorado, Arizona, and New Mexico. It is characterized by high elevation (the general plateau surface has an average elevation of about 5,200 ft [1,600 m], with plateaus and peaks nearly as high as 13,000 ft [4,000 m]) and a deeply incised drainage system, forming steep-walled canyons

FIGURE 3.3-1 Physiographic Map of the Colorado Plateau (modified from Foos 1999)

that expose geologic formations of late Paleozoic and early Mesozoic age. Most of the Colorado Plateau is drained by the Colorado River and its main tributaries, the Green, San Juan, and Little Colorado Rivers (Hunt 1974; Chronic and Williams 2002; Foos 1999).

The Canyon Lands section has been broadly uplifted, and structural features that have been superposed on it have strongly affected its topography (Thornbury 1965). In the eastern part of the Canyon Lands section in the area of the ULP lease tracts, topographic features are mainly related to a series of northwest-striking anticlines and synclines. These structures are caused by flowage or solution of masses of salt and gypsum that were deposited during Pennsylvanian time in the Paradox Basin (Thornbury 1965). The section is also known for its incised canyons that have formed in its drainage system. The example in the lease tracts area is the Dolores River and its canyons and incised meanders.

3.3.1.2 Structural Geology

The Colorado Plateau is an uplifted crustal block that is tectonically distinct from the extensional block-faulted regime of the Basin and Range province (to the west and south) and the Rio Grande rift (to the east). The predominant structural features are northwest trending basement uplifts (such as the Uncompahgre Plateau) that form steeply dipping monoclines with associated structural basins. Most of the tectonic deformation on the plateau occurred during the Laramide orogeny from 70 to 40 million years ago. Uplift of the plateau likely began about 29 million years ago as a result of compression created by extensional zones flanking the region to the west and east. Heat flow measurements throughout the Colorado Plateau indicate low heat flow in the relatively stable interior and high heat flow along the margins (Wong and Humphrey 1989).

The lease tracts are located in the eastern part of the Paradox Basin, an elliptically shaped structural basin that covers about 14,000 mi^2 (36,000 km^2) of the Colorado Plateau in southwestern Colorado and southeastern Utah (Figure 3.3-2). The basin has little surface expression, but is defined as the area on the plateau that is underlain by thick accumulations of evaporites (mainly halite) of the Pennsylvanian age Paradox Formation. The area of northwest-striking anticlines and synclines in the northeast part of the Paradox Basin is known as the Paradox fold and fault belt (Figure 3.3-2). In this belt, the anticlinal structures are known as valleys because their central salt cores have been breached by erosion and the subsequent collapse has formed anticlinal valleys (Thornbury 1965). Strata along the valley sides indicate that diapirism of the salt core occurred as recently as the late Jurassic (about 145 million years ago), especially in the northeastern part of the belt (Hite and Lohman 1973; Chenoweth 1987; Whitfield et al. 1983; Grout and Verbeek 1997; Condon 1997). Synclinal areas between the anticlines have created flat-topped mesas or broad valleys that contrast highly with the fault-bounded anticlinal valleys (Thornbury 1965). The ULP lease tracts are in the eastern part of the Paradox fold and fault belt, in Colorado. Examples of the anticlinal valleys in the lease tracts area are the Paradox and Big Gypsum Valleys; synclinal examples are Dry Creek Basin and Disappointment Valley. Figure 3.3-3 is a shaded relief map showing the locations of the ULP lease tracts.

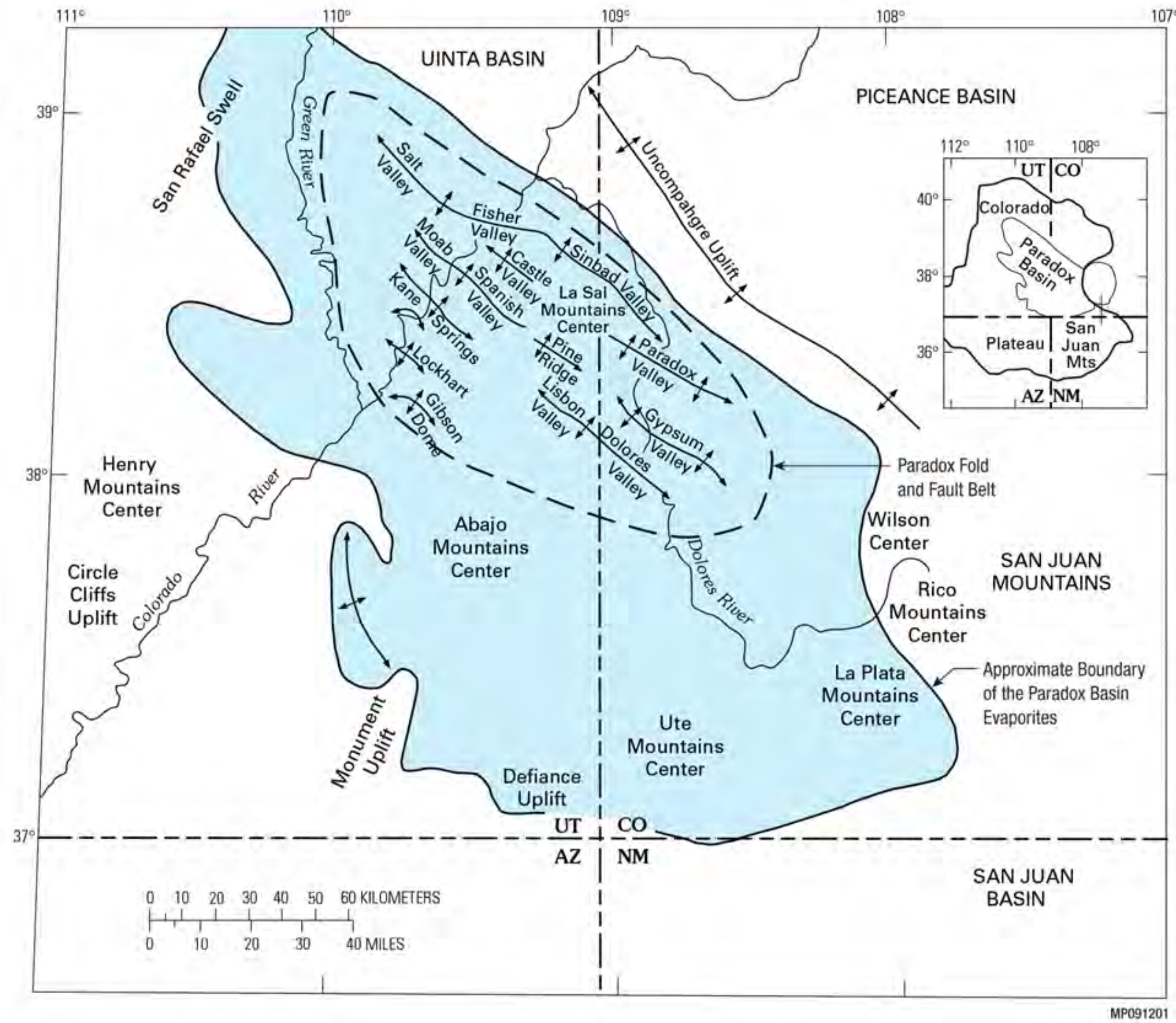

FIGURE 3.3-2 Extent of the Paradox Basin and the Paradox Fold and Fault Belt in Southwestern Colorado and Southeastern Utah (modified from Grout and Verbeek 1997)

To the north of the Paradox Basin is the Uncompahgre Uplift (or Plateau), a northwest-trending, Precambrian basement-cored fold that overlies a basinward-oriented overthrust fault (Figure 3.3-2). Vertical offset along this fault is about 3.7 mi (6 km); horizontal offset, which is mainly left lateral, is about 6.2 mi (10 km) (Grout and Verbeek 1997; Condon 1997).

Relatively young laccolithic intrusions (Oligocene to Miocene age) form several mountain ranges within the basin, including the Abajo and La Sal Mountains in southeastern Utah and the Ute and La Plata Mountains in southwestern Colorado (Figure 3.3-2). These intrusive centers are thought to have been emplaced during a period of crustal extension on the Colorado Plateau (Grout and Verbeek 1997).

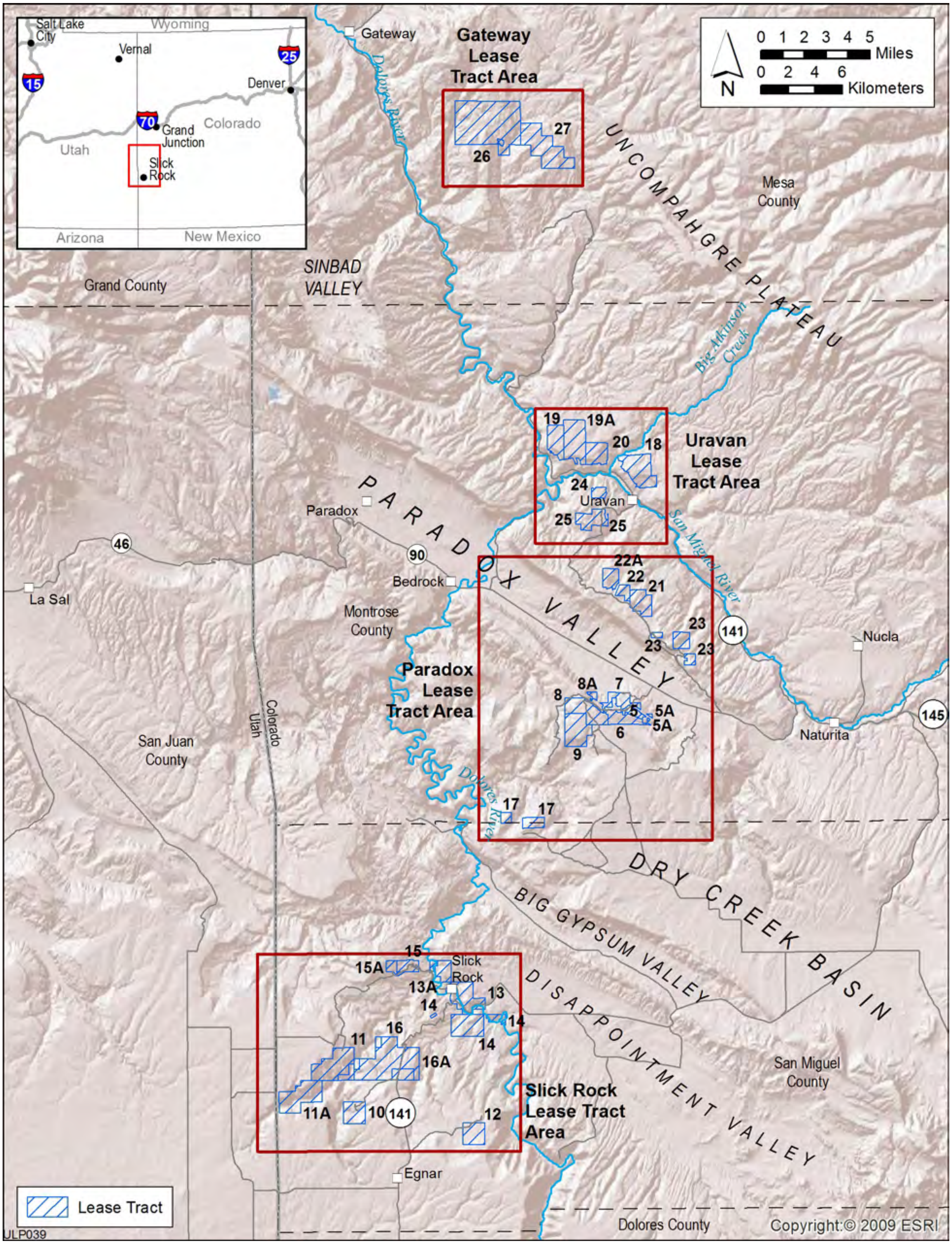

FIGURE 3.3-3 Shaded Relief Map Showing Location of ULP Lease Tracts

Crossing the anticlines and synclines of the Paradox fold and fault belt is the Uravan Mineral Belt, which generally contains the most productive uranium-vanadium deposits (Figure 3.3-4). This north-to-south arcuate band of the mineral belt encompasses all of the ULP lease tracts (Figure 3.3-3). The uranium-vanadium deposits in the mineral belt and the geology of the individual lease tracts are described in Sections 3.3.1.3.2 and 3.3.1.5, respectively.

3.3.1.3 Bedrock Geology

The geology of the area covering the ULP lease tracts and vicinity is shown in Figure 3.3-5. Exposed geologic units are predominantly sedimentary rocks of Cretaceous (Mancos Shale, Dakota Sandstone, and Burro Canyon Formation) and Jurassic (Morrison Formation) age.

3.3.1.3.1 Stratigraphy. The general stratigraphy of the Paradox Basin is shown in Figure 3.3-6. Selected bedrock formations cropping out in the lease tracts—from the Chinle Formation (Upper Triassic) to the Dakota Sandstone (Lower Cretaceous)—are described here in ascending order (oldest to youngest). Quaternary surficial deposits (alluvium, colluvium, and talus) occur throughout the basin and are found in abundance in river valleys and canyon bottoms.

Chinle Formation (Upper Triassic). The Chinle Formation is composed predominantly of siltstone, shale, conglomerate, and sandstone. Sediments of the formation were deposited on the southwestern edge of a nonmarine back-arc basin centered on the four corners region about 250 million years ago (Hazel 2000). Outcrops of the formation occur along the bottom of Summit Canyon and Dolores River Canyon. Its lowest unit, the Moss Back Member, is a fine-grained sandstone with thin layers of mudstone, siltstone, shale, and conglomerate. The unit is about 60 ft (18 m) thick and unconformably overlies the Moenkopi and Cutler Formations (Lower Triassic to Permian). In the Slick Rock area, the Moss Back Member is thought to comprise a system of coalescing channel-fill deposits with a northwestward trend. It is the only unit in the Chinle Formation that is known to be a host rock for uranium deposits (Shawe et al. 1968; Shawe 2011).

Entrada Sandstone (Middle Jurassic). The Entrada Sandstone is a fine-grained unit that is moderately well sorted, with thick to very thin crossbedded units and wavy-parallel laminated units. It is normally a reddish-brown color but is bleached to a yellowish brown in areas where it is overlain by the Pony Express Limestone Member of the Wanakah Formation. In the lease tracts, it has a whitish appearance in outcrop that makes it a good marker bed for discerning the approximate base of the Salt Wash Member of the Morrison Formation. Near Uravan, the formation sits unconformably atop the Kayenta Formation (Lower Jurassic) or a thin remnant of the Navajo Sandstone (Lower Jurassic). This unconformity, known as the J-2, is traceable throughout the U.S. western interior. Vanadium-uranium-chromium mineralization has been well

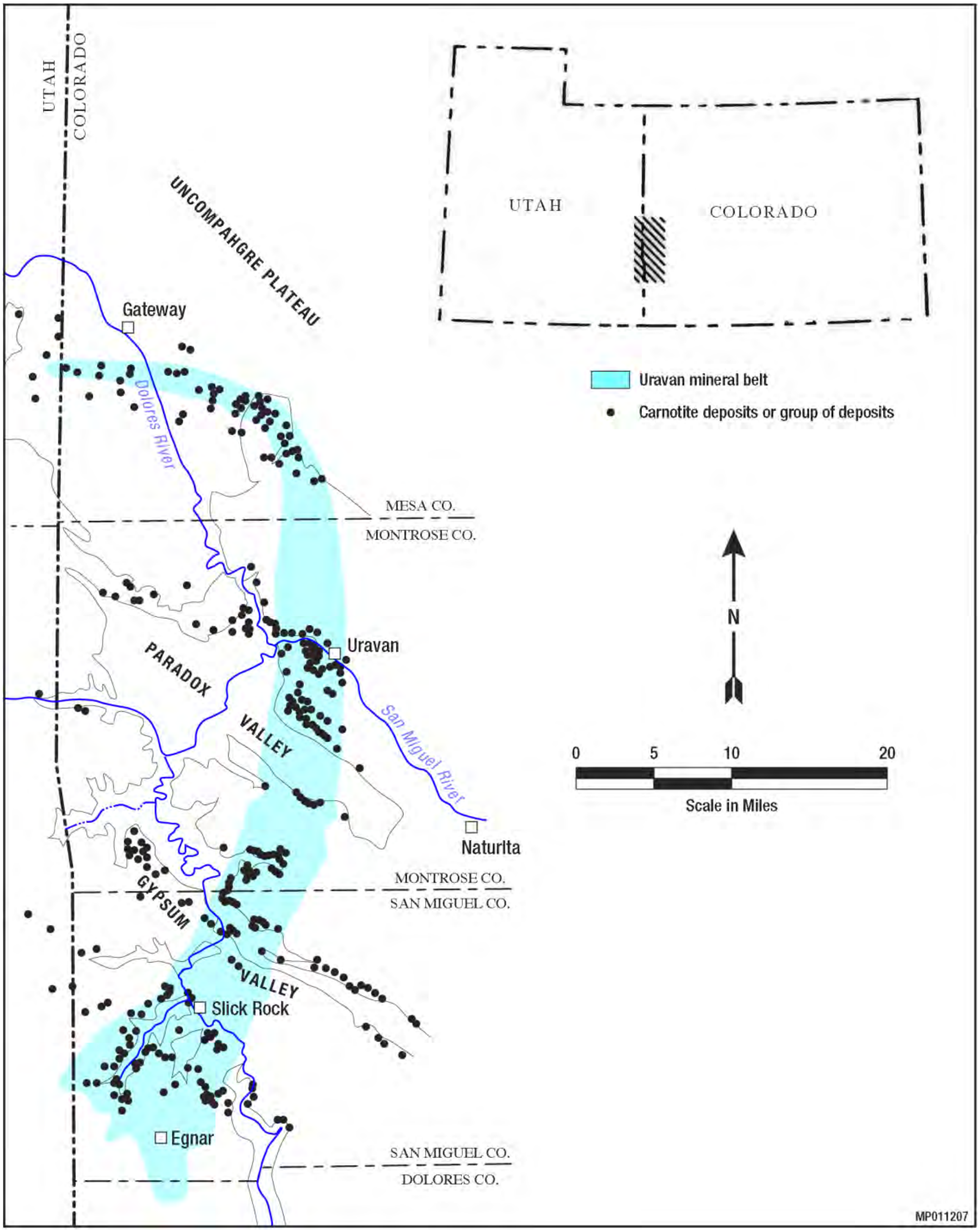

FIGURE 3.3-4 Extent of the Uravan Mineral Belt in Relation to Known Uranium-Vanadium Deposits (modified from Fischer and Hilpert 1952)

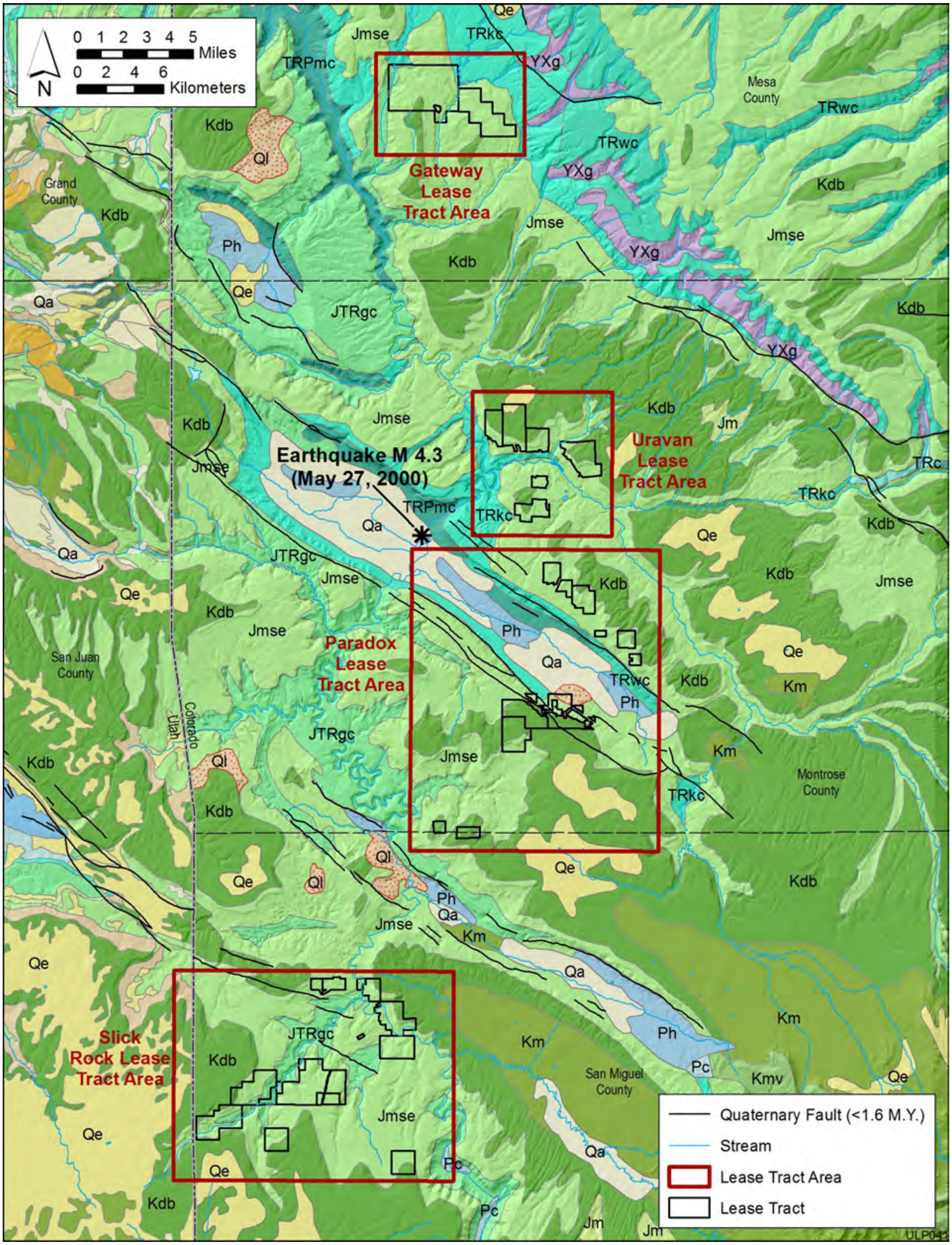

FIGURE 3.3-5 Geologic Map Covering the ULP Lease Tracts (Stoeser et al. 2007; Tweto 1979; source of mapped faults and earthquake is USGS 2012)

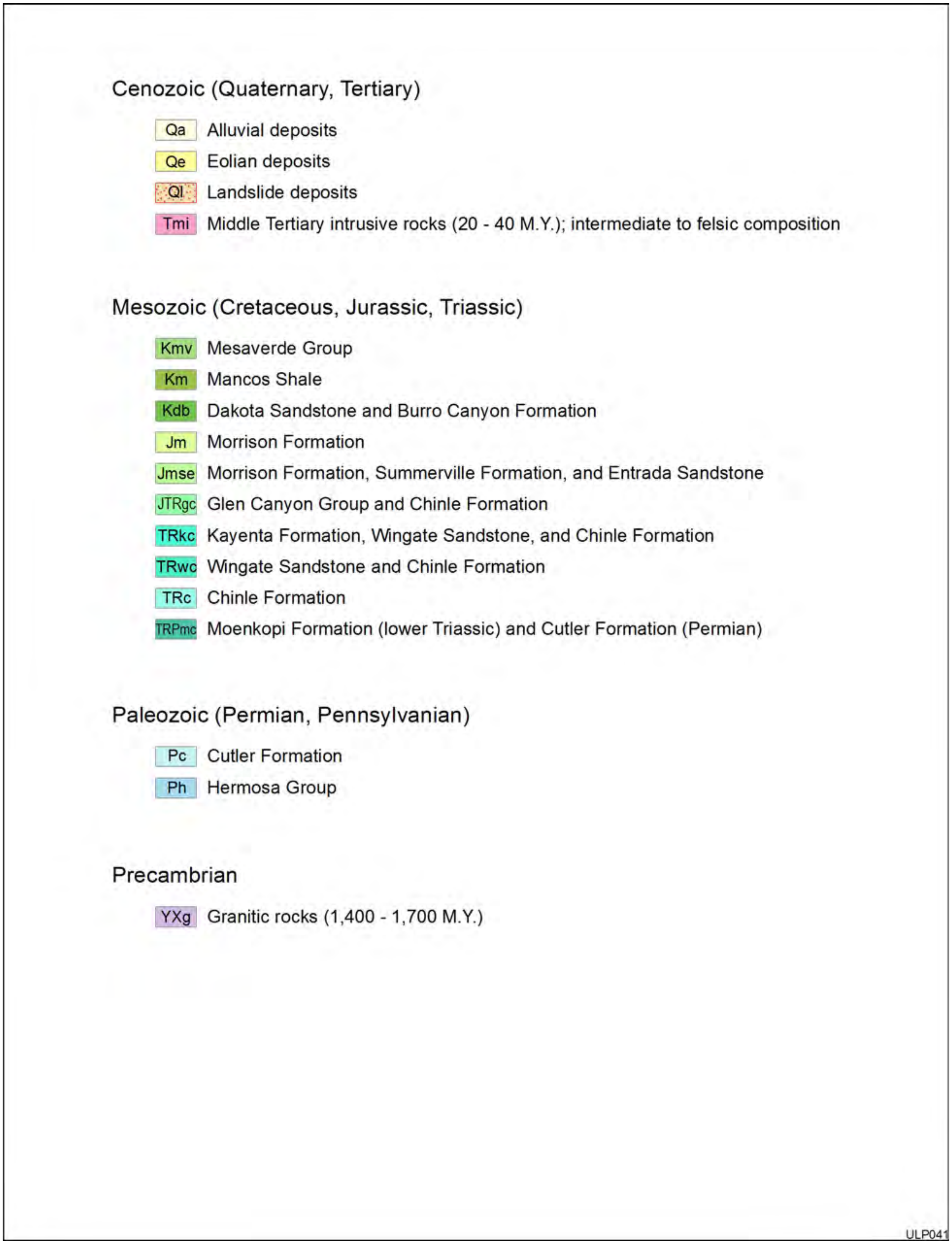

FIGURE 3.3-5 (Cont.)

Era	Period	Million Years before Present	Stratigraphic Unit	Unit Thickness (feet)	Physical Characteristics
Cenozoic	Quaternary	0 – 2.6	Alluvium	0–100	Alluvium sands and gravels, loess, colluvium, windblown sands
Mesozoic	Upper Cretaceous	65.5 – 99.6	Mesaverde Group	100–1,000	Sandstone, siltstone, and shale; major coal beds in lower part
			Mancos Shale	1,000–5,000	Shales interbedded with minor sandstone
			Dakota Sandstone	0–200	Fine-to coarse-grained cross-bedded sandstone; coal present.
	Lower Cretaceous	99.6 – 145.5	Burro Canyon Fm	0–250	Conglomerate, sand-stone and shale
	Upper Jurassic	145.5 – 161	Morrison Formation: Brushy Basin Member	400–500	Shales interbedded with minor sandstone
			Morrison Formation: Salt Wash Member	300	Medium-grained sand-stone interbedded with red shale
	Lower and Middle Jurassic	161 – 201.6	Wanakah Fm (Summerville Fm)	0–120	Shales interbedded with minor sandstone
			Entrada Sandstone	15–170	Buff to grayish-white cross-bedded sandstones
			Carmel Formation	0–40	Siltstone and mudstone interbedded with fine-grained sandstone
			Navajo Sandstone	0–125	Fine-grained, cross-bedded quartz sandstone
			Kayenta Formation	0–200	Sandstone interbedded with siltstone and thin-bedded shale
	Upper Triassic	201.6 – 235	Wingate Sandstone	0–400	Medium-grained, poorly cemented, cross-bedded sandstone
			Dolores Formation	150–230	Pink to red mudstone and fine-grained sandstone. Present in southeast part of basin.
			Chinle Formation	0–500	Shale, siltstones, interbedded with minor fine-grained sandstone
	Lower Triassic	235 – 251	Moenkopi Formation	0–480	Mudstone interbedded with minor sandstone
Paleozoic	Permian	251 – 299	Cutler Formation	0–3,500	Fine-grained sandstone interbedded with minor conglomerate and mudstone
	Pennsylvanian	299 – 318	Hermosa Group	0–3,900	Shales, limestones, salt and gypsum; includes the Paradox Formation
	Mississippian	318 – 359	Leadville Limestone	20–100	Massive to thinly laminated, gray buff and yellow limestone
	Devonian to Cambrian	359 – 542	Ouray, Elbert, and Ignacio Formations	0–150	Limestone, shale, dolomite; Ignacio is a quartzite

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FIGURE 3.3-6 Generalized Stratigraphy of the Paradox Basin (based on Topper et al. 2003, Walker and Geissman 2009, and Molenaar 1987)

documented in the upper part of the Entrada Sandstone (e.g., to the southeast of Uravan near Placerville) (Steele 1985).

Wanakah (also known as the Summerville) Formation (Middle Jurassic). The Wanakah Formation unconformably overlies the Entrada Sandstone and is of marine and marginal marine origin. It is composed of three members—the upper Marl Member, the middle Bilk Creek Sandstone Member, and the lower Pony Express Limestone Member—but is undifferentiated in places. The upper unit (Marl) consists of alternating thin lenticular beds of fine-grained sandstone, siltstone, mudstone, and claystone; the middle unit (Bilk Creek) consists of a moderately well sorted, fine-grained sandstone and an upper unit of well-indurated carnelian sandstone. These units are underlain by a limestone unit (Pony Express) with scattered silt-sized quartz and feldspar grains (Steele 1985).

Morrison Formation (Upper Jurassic). The Morrison Formation occurs throughout the U.S. western interior and its greatest known thickness is in the Slick Rock area, where a cored section near Disappointment Valley is more than 1,100 ft (340 m) thick. In the lease tracts area, the formation consists of two members: the lower Salt Wash Member and the upper Brushy Basin Member. Sediments of the Salt Wash Member are composed of interbedded, fluvial sandstones and mudstones deposited in stream channels and floodplains. These sediments were laid down in an area of downwarping that resulted in a fan-shaped apron of thick sediment within the main alluvial plain of deposition. This sediment apron, with its continuous sandstone beds and abundant carbonized plant material, comprises the Salt Wash Member and is the host rock for most of the uranium-vanadium deposits in the Paradox Basin. In the Slick Rock area, the Salt Wash Member is about 300 ft (90 m) thick. The Brushy Basin Member conformably overlies the Salt Wash Member. It consists predominantly of bentonitic mudstones, suggesting deposition in a low-energy lacustrine environment. The sediments of the Brushy Basin Member have a high devitrified volcanic glass content (from ashfalls). Some investigators have suggested that the volcanic glass was originally uranium-rich and that uranium was released during the devitrification process. This would make the Brushy Basin Member a possible source of uranium in the underlying Salt Wash Member ore deposits (Shawe 2011; Breit and Fisher 1988; Mullins and Freeman 1954).

Burro Canyon Formation (Lower Cretaceous). The Burro Canyon Formation overlies the Brushy Basin Member of the Morrison Formation. Its type locality is near Slick Rock in San Miguel County. The formation is composed of alternating beds of conglomeratic sandstone and mudstone, with minor chert and limestone. Sandstone units are most abundant in the lower part of the formation, forming ledges and vertical cliffs in outcrop; mudstones predominate in the upper units and tend to form gentle to steep slopes. Together these units are thought to reflect a sequence of high-energy deposition in a fluvial environment during a period of tectonic uplift (lower sandstone) followed by a period of tectonic quiescence and low-energy deposition (upper mudstones). The thickness of the formation is variable across short distances, but in the lease tracts, it is consistently 130 ft (40 m) or more thick (with a maximum thickness of about 300 ft (90 m) measured in a drill hole in Disappointment Valley) (Craig 1982).

Dakota Sandstone (Upper Cretaceous). The Dakota Sandstone unconformably overlies the Burro Canyon Formation and consists mainly of fine- to medium-grained sandstone with a basal unit of conglomerate and a middle unit of carbonaceous shale and mudstone (fossil plants, pyrite, and coal are also present) (Shawe et al. 1968; Simmons 1957). Along with the Burro Canyon Formation, this unit forms the caprock of several mesas in the lease tracts.

3.3.1.3.2 Uranium Deposits. The uranium deposits of the Salt Wash Member are known as "sandstone-type" deposits. These are epigenetic concentrations of uranium minerals that occur in fluvial, lacustrine, and deltaic sandstone formations in either continental or marginal marine environments. The dominant host rocks are fine- to medium-grained sandstones of various composition; uranium minerals are typically very fine-grained and occupy the intergranular spaces of the host rock or locally replace fossil wood and bones. Other ore-grade minerals, such as vanadium, copper, and trace metals (molybdenum, selenium, chromium, and radium), are found in association with uranium deposits in the Salt Wash Member (Finch and Davis 1985).

The Uravan Mineral Belt was defined in the early 1950s to delineate the area of the most concentrated and most productive uranium-vanadium deposits in sandstones of the Salt Wash Member of the Morrison Formation that had been found up to that time (Fischer and Hilpert 1952). Boundaries of the belt are approximate; at that time, some of the deposits were outside of the belt. Since that time, additional deposits have been found by deeper exploratory drilling and other improved exploration methods both within and outside the boundaries of the mineral belt (Figure 3.3-4).

Most of the mineralized zones in the Salt Wash Member are tabular (lenticular) and concordant with bedding planes; however, some deposits cut across bedding in smooth curves to form rolls or roll fronts, especially near the edge of the ore body. Tabular deposits are thought to have precipitated at chemical interfaces between connate pore waters and infiltrating groundwater solutions; in contrast, roll-front deposits likely precipitated at a redox interface of oxidizing recharge waters enriched with uranium passing through a reducing pyrite-bearing sandstone. Sedimentary features have an important influence on the shape and distribution of deposits in the Salt Wash Member. Most of the Salt Wash deposits are elliptical in plain view and tend to cluster along the margins of major channels. More locally, individual deposits concentrate along features that produce permeability changes, such as shale horizons. Faults also play a role in mineral deposition by providing conduits for mineralizing solutions to access the host rock (Chenoweth 1981; Finch and Davis 1985; Shawe 2011).

3.3.1.4 Seismicity

Seismicity on the Colorado Plateau is characterized as small to moderate in magnitude with a low to moderate rate of earthquake occurrence. Most seismic activity is concentrated in the Wasatch Plateau-Book Cliffs region (north of Paradox Basin), where numerous small-magnitude earthquakes are generated by coal mining. Earthquakes on the plateau generally occur in the upper crust, ranging in depth from the near-surface to 9 to 12 mi (15 to 20 km) (Wong and Humphrey 1989).

The lease tracts are located in the southeastern region of the Paradox Basin known as the Paradox fold and fault belt in the eastern part of the Paradox Basin (Figure 3.3-2). In this belt, normal faulting is associated with salt anticlines that have collapsed along their crests to form graben-like structural features. An example of such a fault is U.S. Geological Survey (USGS) No. 2286, a high-angle normal fault that trends northwestward along the Paradox Valley graben following the general trend of the valley (Figure 3.3-2). Faults along the edges of the graben are well-defined, and Quaternary movement has been inferred by several investigators. However, no evidence has been found to suggest Holocene age movement has occurred (Widmann 1997; Kirkham and Rogers 1981).

Seismic activity in the Paradox Basin is generally low, and earthquakes are of small magnitude and diffusely distributed (Wong and Humphrey 1989). From January 2000 through August 2012, only 13 earthquakes (of any magnitude) have been recorded within a 62-mi (100-km) radius of Paradox Valley; the most recent earthquake occurred on March 6, 2012 and registered a surface wave magnitude (MLg)[10] of 2.7. The largest earthquake occurred on May 27, 2000. It was located along the Dolores River in the central part of the valley and registered 4.3 MLg (Figure 3.3-5). Since 1980, only 10 of the 28 recorded earthquakes (36%) within a 62-mi (100-km) radius of Paradox Valley had surface wave magnitudes that were equal to or greater than 3.0 (USGS 2012a).

Ake et al. (2005) has noted the occurrence of more than 4,000 human-induced seismic events in Paradox Valley caused by high-pressure subsurface injections of brine by the U.S. Bureau of Reclamation (BOR) at its Paradox Valley Unit, located in Bedrock, Colorado (see Sections 3.9.1.1, 3.4.1.2, and 3.4.3 for information on the Paradox Valley Unit). Most of these events registered magnitudes too small to be felt (less than M 2.5); however, at least 15 have been felt, including the M 4.3 event that occurred in May 2000. The BOR has modified its injection strategy since 1996, and these changes have reduced the frequency of induced seismic events to as low as 60 events per year (most of which are not felt).

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[10] Surface wave magnitude (MLg) is used for earthquakes with magnitudes of 5 to 8 and is based on the amplitude of the Lg surface wave (USGS 2012b).

3.3.1.5 Topography and Geology of the Lease Tracts

3.3.1.5.1 Gateway Lease Tracts. The Gateway lease tracts are located southeast of the town of Gateway at the northern end of the Uravan Mineral Belt (Figures 3.3-3 and 3.3-4). The two lease tracts, 26 and 27, are located on the tops and side slopes of Calamity and Outlaw Mesas, respectively. Sedimentary rocks cropping out on side slopes below the mesa rims range in age from Triassic to Cretaceous; Cretaceous sandstone and conglomerate cap the mesas (Figure 3.3-5). Uranium-vanadium deposits occur in the Salt Wash Member of the Morrison Formation (Upper Jurassic), and this unit has been mined extensively for nearly 100 years. Surface runoff from the mesas drains to Maverick and Calamity Creeks, tributaries of the Dolores River. Elevations of the Gateway lease tracts range from 5,700 to 7,000 ft (1,700 to 2,100 m) above sea level (Figure 3.3-7).

3.3.1.5.2 Uravan Lease Tracts. The six Uravan lease tracts are located immediately north, northwest, and west of the town of Uravan on the tops and side slopes of Atkinson Mesa (Lease Tracts 19, 19A, and 20), Spring Creek Mesa (Lease Tract 18), and Club Mesa (Lease Tracts 24 and 25) (Figure 3.3-8) in the central part of the Uravan Mineral Belt (Figures 3.3-3 and 3.3-4). The lease tracts in this region sit on the northeastern flank of the Paradox Valley anticline, where regional folds have a northwestern trend. There are no known major faults in the region (Joesting and Byerly 1958; Boardman et al. 1957).

Sedimentary rocks exposed in the Club Mesa area dip slightly to the northeast and are of Mesozoic age (Figure 3.3-5). These include the pre-Morrison Formations of Triassic and Jurassic age, the Morrison Formation (Upper Jurassic), and remnants of the Burro Canyon Formation (Lower Cretaceous). In this region, the Morrison Formation is the host rock for all uranium-vanadium deposits. The Salt Wash Member of the formation ranges in thickness from about 200 to 300 ft (60 to 90 m); the overlying Brushy Basin Member is about 400 to 450 ft (120 to 140 m) thick. Most of the uranium-vanadium deposits occur in the Salt Wash Member; small deposits also occur near the base of the Brushy Basin Member (Boardman et al. 1957).

The Dolores River and its main tributary, the San Miguel River, flow in the valley bottoms below the lease tracts. The canyon bottoms consist of unconsolidated fluvial deposits. Bedrock formations exposed along the lower slopes of the canyons are the Wanakah Formation (formerly the Summerville Formation) and the Entrada Sandstone (both Middle Jurassic). Below the Entrada Sandstone are rocks of the Kayenta Formation (Lower Jurassic) and the Wingate and Chinle Formations (Upper Triassic). Elevations of the Uravan lease tracts range from 5,100 to 6,400 ft (1,560 to 1,950 m) above sea level (Figure 3.3-8).

3.3.1.5.3 Paradox Lease Tracts. The Paradox lease tracts are located on the high plateaus that flank Paradox Valley in the central part of the Uravan Mineral Belt (Figures 3.3-2 and 3.3-4). Lease Tracts 5, 5A, 6, and 7 and a portion of Lease Tracts 8 are on the steep northeast

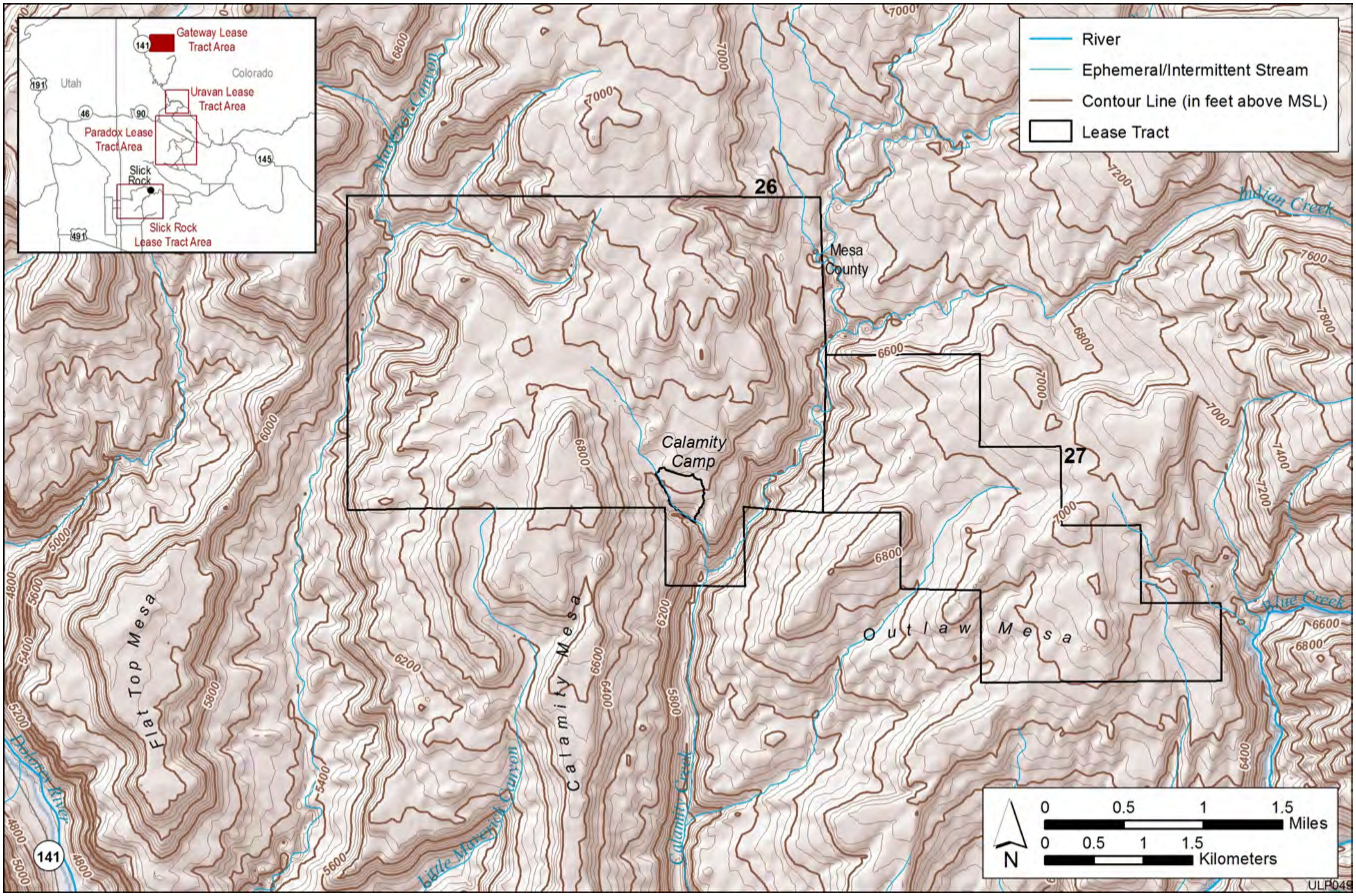

FIGURE 3.3-7 Topography of the Gateway Lease Tracts

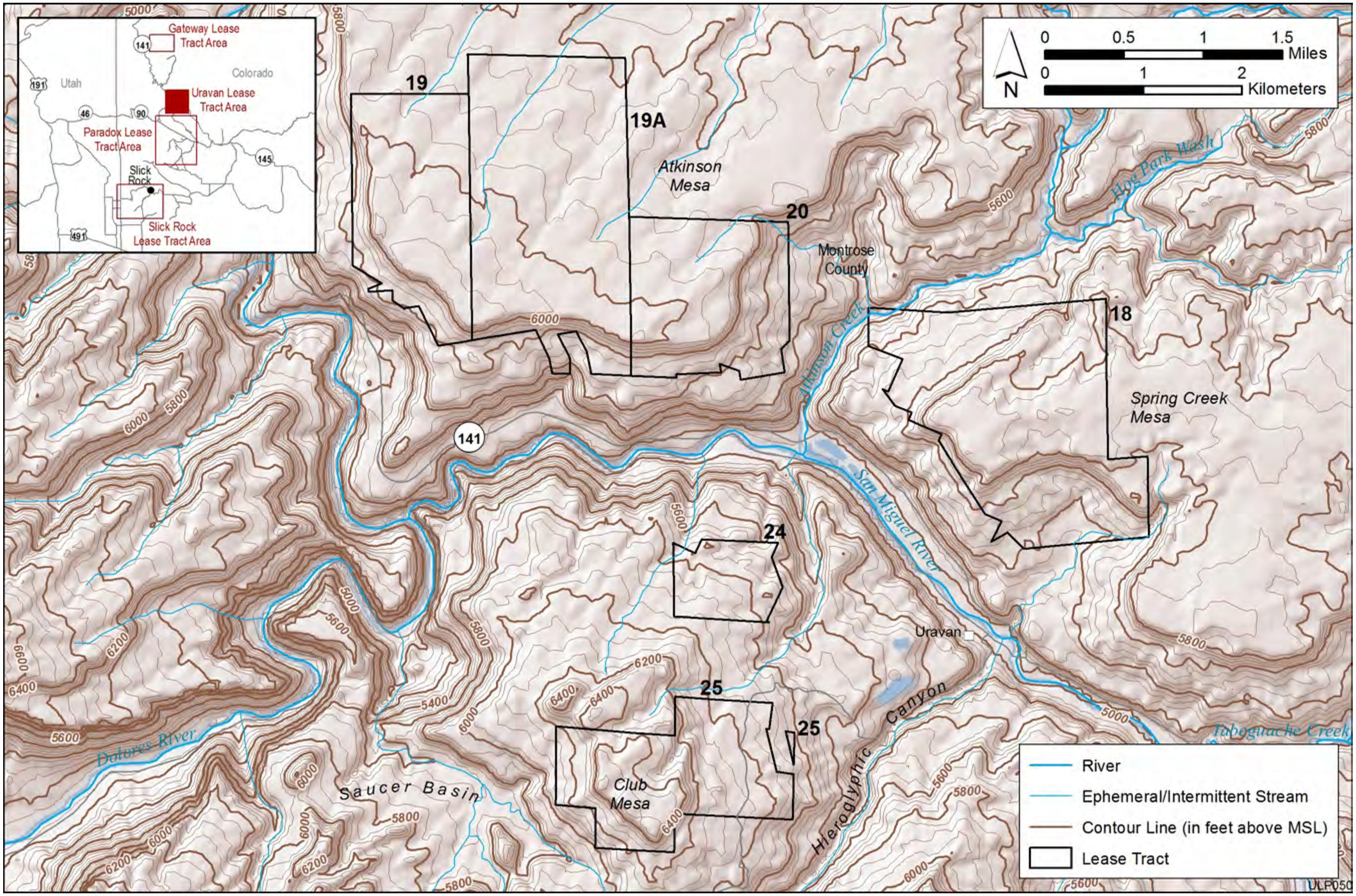

FIGURE 3.3-8 Topography of the Uravan Lease Tracts

aspect of Monogram Mesa along the southwestern flank of the valley. The remainder of Lease Tract 8 and all of Lease Tract 9 sit on the top of Monogram Mesa. The steep northeast aspect of Monogram Mesa is formed by a series of structurally complex, faulted slump blocks composed of the Brushy Basin and Salt Wash Members of the Morrison Formation (Upper Jurassic). Overlying the Morrison Formation and forming the caprock of the mesa are the Burro Canyon Formation (Lower Cretaceous) and the Dakota Sandstone (Upper Cretaceous) (Figure 3.3-5).

Lease Tracts 21, 22, 22A, and 23 are on a plateau know as Long Park, along the northeastern flank of Paradox Valley. Lease Tracts 17-1 and 17-2 are located farther to the southwest on top of Radium Mountain and Wedding Bell Mountain, respectively. The geology of the Long Park plateau area is similar to that of Monogram Mesa, except that the formations underlying Long Park plateau area (capped by the Brushy Basin Member of the Morrison Formation) dip to the northeast. Elevation of the Paradox Valley floor is 5,500 to 5,600 ft (1,680 to 1,700 m) above sea level, about 1,000 ft (300 m) below the tops of the adjacent mesas to the north and 1,600 ft (490 m) below the top of Monogram Mesa to the south (Figure 3.3-9).

Lease Tract 17 is located farther to the southwest and consists of two parcels, 17-1 and 17-2 (west and east). The west parcel is on top and along the sides of Wedding Bell Mountain. The east parcel is on top and along the sides of Radium Mountain. Both mountains are capped by the Burro Canyon Formation (Lower Cretaceous) and Dakota Sandstone (Upper Cretaceous), and the side slopes of both mountains contain exposures of both members (Brushy Basin and Salt Wash) of the Morrison Formation (Upper Jurassic).

3.3.1.5.4 Slick Rock Lease Tracts. The Slick Rock lease tracts are located in the Slick Rock mining district at the southern end of the Uravan Mineral Belt (Figures 3.3-3 and 3.3-4). Major faults in the region have a northwest trend and run parallel to the collapsed Gypsum Valley salt anticline that lies to the northeast. The Disappointment syncline is just to the southwest of the Gypsum Valley anticline (Shawe 1970, 2011).

Sedimentary rocks cropping out in the region range in age from Permian to Cretaceous and are at least 4,700 ft (1,400 m) thick (Figure 3.3-5). These rocks and the older Paleozoic sedimentary rocks that underlie them together are about 13,000 ft (4,000 m) thick. Uranium and vanadium deposits occur in the Moss Back Member of the Chinle Formation (upper Triassic) and several levels of the Morrison Formation (upper Jurassic); however, most of the important ore production has been from the Salt Wash Member of the Morrison Formation (Shawe et al. 1968; Shawe 2011).

The 11 lease tracts in the Slick Rock area are located near the Dolores River, which flows northward through the narrow, steep-walled Dolores River Canyon. The canyon bottom and lower slopes consist of unconsolidated fluvial deposits and alluvial/colluvial deposits, respectively. In the northern part of the Canyon, near the town of Slick Rock, the canyon floor is underlain by the Entrada Sandstone. Bedrock formations exposed along the canyon walls and adjoining mesas include, in ascending order, the Salt Wash and Brushy Basin Members of the Morrison Formation (Upper Jurassic), and the Burro Canyon Formation and the Dakota

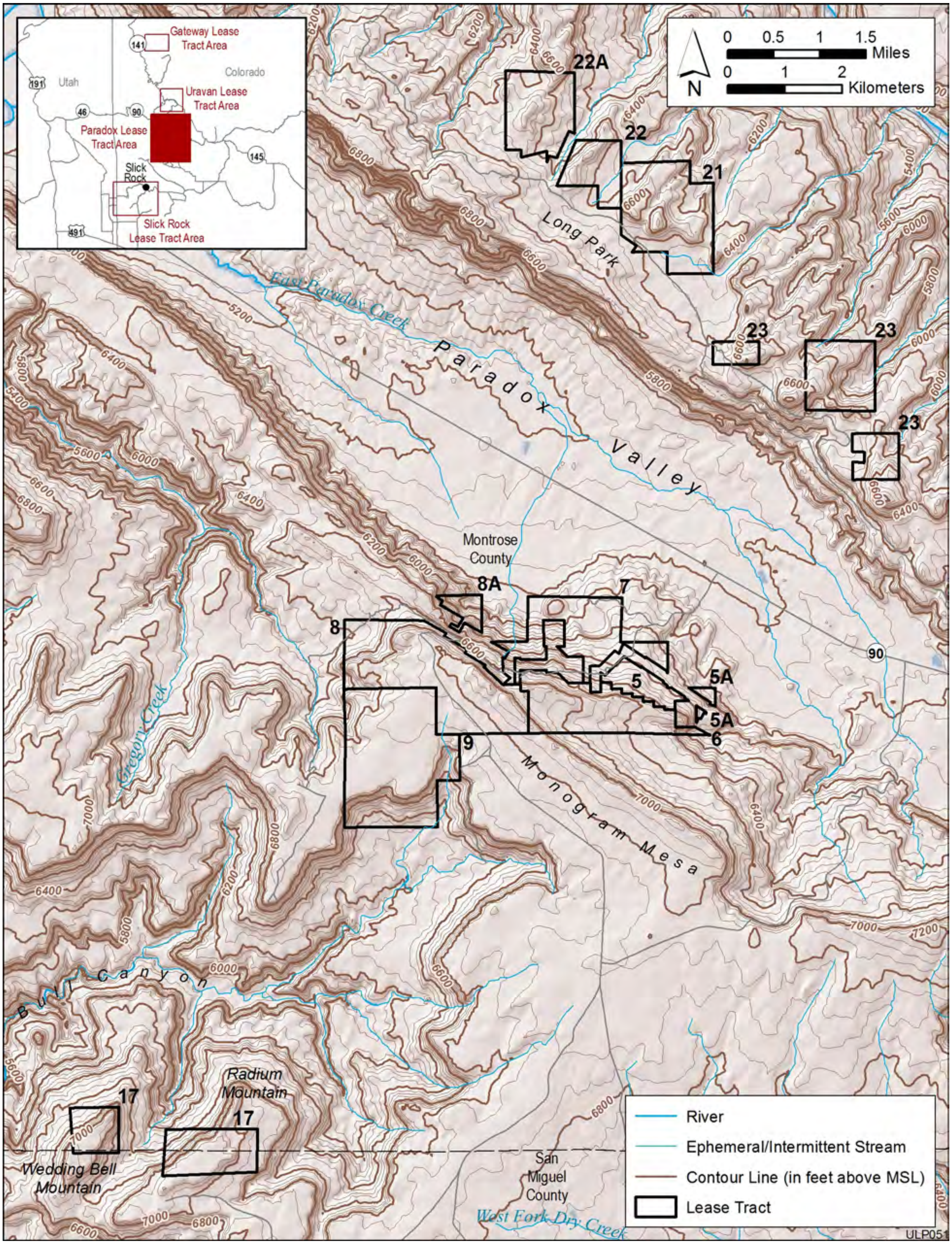

FIGURE 3.3-9 Topography of the Paradox Lease Tracts

Sandstone (Lower Cretaceous). Lease Tracts 13, 13A, and 14 lie within the Dolores River Canyon or on adjacent ridges. Lease Tracts 15 and 15A are located west of and above the Dolores River on the first topographic bench near Cougar Point. Lease Tracts 11 and 11A are to the southwest of the town of Slick Rock in the western part of Summit Canyon, near the top of Summit Point. Lease Tracts 10, 12, 16, and 16A lie just south of the top of Slick Rock Hill. Elevations of the Slick Rock lease tracts range from 5,400 ft (1,650 m) above sea level along the Dolores River to nearly 8,000 ft (2,400 m) above sea level on the mesa top east and north of Egnar, Colorado (Figure 3.3-10).

3.3.1.6 Paleontological Resources

Significant paleontological resources in the lease tracts are associated with Mesozoic age geologic units (formations), especially those from the Jurassic and Cretaceous Periods (206 to 65 million years ago). These units are of marine and nonmarine origin and yield important vertebrate fossils, including fish, frogs, salamanders, turtles, crocodiles, pterosaurs, mammals, birds, and dinosaurs (Armstrong 1982; USFS and BLM 2013). Invertebrate fossils (e.g., ammonites) and plants are also abundant. They generally have a high Potential Fossil Yield Classification (PFYC)[11] ranking that indicates a high fossil yield and a great sensitivity to adverse impacts. Table 3.3-1 lists the geologic units potentially affected in the lease tracts and their PFYC ranking. The Morrison Formation is the main source of uranium in the lease tracts and likely would be the geologic unit most affected by future mining. The table includes deeper (older) geologic units because uranium is also known to occur in the Chinle Formation in the Slick Rock area (see Section 3.3.1.3.1).

Various statutes, regulations, and policies govern the management of paleontological resources on public lands. Congress recently passed a paleontology law, titled “Paleontological Resources Preservation under the Omnibus Public Lands Act of 2009” (P.L. 111-11, codified at 16 USC 470aaa), also known as the PRPA (for Paleontological Resources Preservation Act). The PRPA establishes three main points: (1) paleontological resources collected under a permit are U.S. property and must be available for scientific research and public education and preserved in an approved facility; (2) the nature and location of paleontological resources on public lands must be kept confidential to protect those resources from theft and vandalism; and (3) theft and vandalism of paleontological resources on public lands can result in civil and criminal penalties including fines and/or imprisonment. The law also requires an expansion of public awareness and education regarding the importance of paleontological resources on public lands and the development of management plans for inventory, monitoring, and scientific and educational use of paleontological resources (BLM 2009c).

[11] The PFYC system is used by the BLM to classify the potential for significant paleontological resources to occur in a geologic unit and to assess possible resource impacts and mitigation needs for Federal actions involving land disturbance. The PFYC rankings range from Class 1 (very low) to 5 (very high); units with an unknown potential are typically assigned a Class 3 (moderate) rank until further study can be conducted. Geologic units with high PFYC rankings (Classes 4 and 5) are highly fossiliferous and are most at risk of human-caused adverse impacts or natural degradation (BLM 2007c).

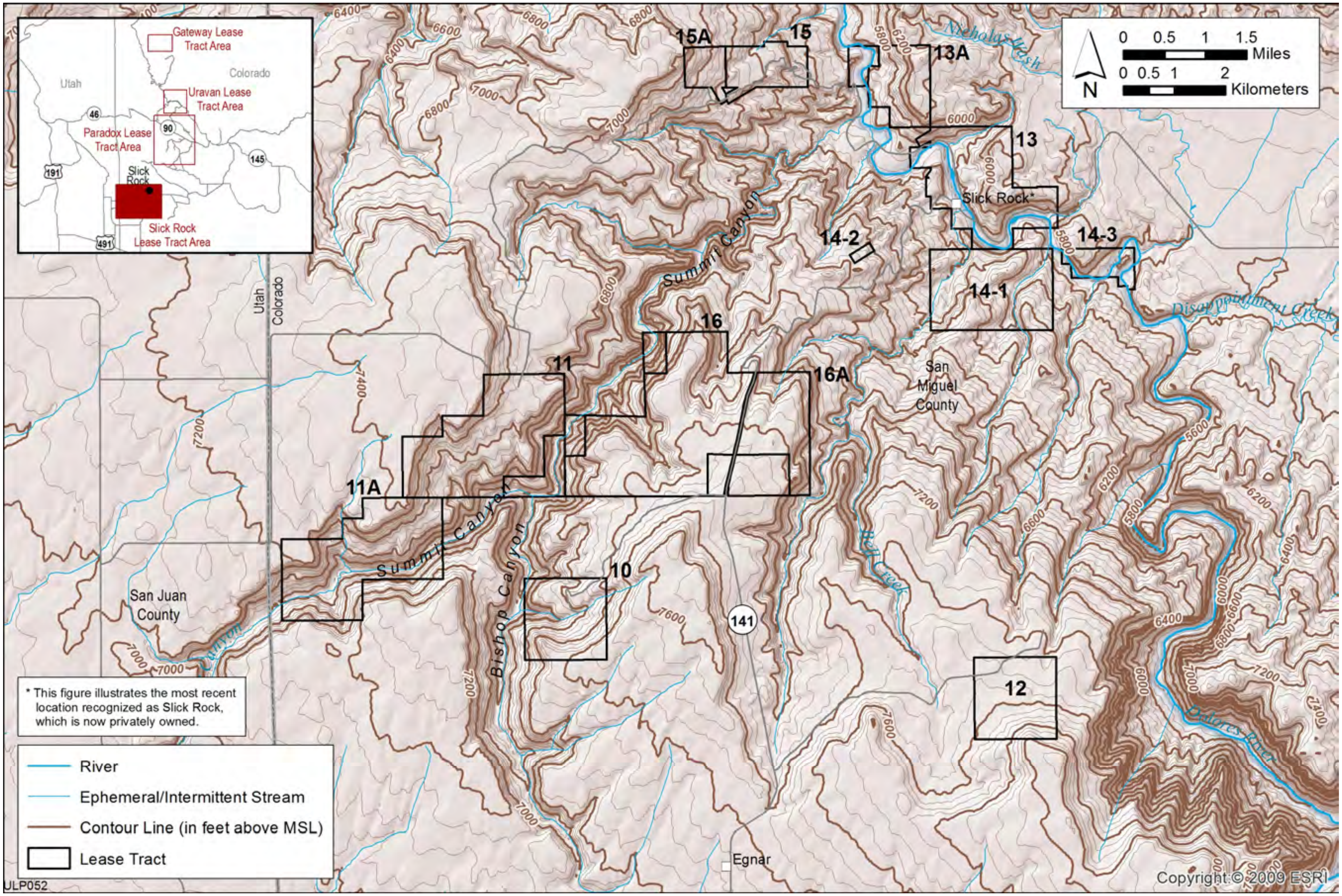

FIGURE 3.3-10 Topography of the Slick Rock Lease Tracts

TABLE 3.3-1 Geologic Units in the Lease Tracts and Their PFYC Ranking

Geologic Unit	PFYC	Known Fossil Resources
Alluvium (Quaternary)	2-3	Mammals (shrub ox)
Mancos Shale (Upper Cretaceous)	2-3	Invertebrates (ammonites, oysters, brachiopods, clams), sharks, large marine reptiles, fish, dinosaurs, pollen, plants, and trace fossils (e.g., crayfish borrows)
Dakota Sandstone (Upper Cretaceous)	5	Dinosaur bones and tracks; plants
Burro Canyon Formation (Lower Cretaceous)	3	Invertebrates and plants
Morrison Formation (Upper Jurassic)	5	Dinosaurs, lizards, other reptiles, birds, mammals, amphibians, fish, invertebrates, and plants
Wanakah Formation (Middle Jurassic)	4/5	Dinosaurs, early mammals, seed plants, ferns, marine reptiles, fish, sharks and rays, ammonites, and plankton
Entrada Sandstone (Middle Jurassic)	4/5	Dinosaurs, early mammals, seed plants, ferns, marine reptiles, fish, sharks and rays, ammonites, and plankton
Dolores Formation (Upper Triassic)	3	Flowering plants
Chinle Formation (Upper Triassic)	4/5	Vertebrate (fish) and plants

Source: USFS and BLM (2013)

Paleontological resources are also managed and protected under the Federal Land Policy and Management Act (FLPMA; P.L. 94-579, codified at 43 USC 1701-1782) and Theft and Destruction of Government Property (18 USC 641), which penalizes the theft or degradation of property of the U.S. Government; see BLM Manual 8270 (*Paleontological Resource Management*) for complete listing of applicable regulations (BLM 1998, 2007c, 2008f).

3.3.2 Soil Resources

Soil formation results from the complex interactions among parent (geologic) material, climate, topographic relief, natural vegetation, and soil organisms over long periods of time. The classification of soils is based on their degree of development into distinct layers or horizons and their dominant physical and chemical properties. In this section, soils in the lease tracts are represented by map units from soil surveys (originally mapped at the 1:24,000 scale) available through the Natural Resources Conservation Service's (NRCS's) online Web survey. Map units consist of soils of different series or of different phases within one series. On the maps that follow, the map units are typically of two types: soil complexes (two or more soils intermingled) or soil associations (adjacent soils that commonly occur together and are difficult to delineate). Rocky areas that have shallow or severely eroded soils are classified as rock outcrops (Spears and Kleven 1978; Hawn 2003).

Most of the soils in the lease tracts are formed in the residuum of weathered sandstone or shale. Soils that formed in weathered sandstone are generally sandy; soils formed in weathered shale are generally clayey. Soils formed in mixed alluvium (derived from both sandstone and shale) in major valleys and bordering uplands tend to be loamy (Spears and Kleven 1978). The potential for wind and water erosion of soils on the relatively flat mesa tops is slight to moderate (but can be higher in localized areas); however, the potential for soil erosion on steep side slopes (where soil is present) is moderate to severe.

Biological soil crusts are commonly found throughout the Colorado Plateau. They consist of surface crusts formed by soil particles bound together by living organisms and their by-products. Most of the biological soil crusts on the plateau are composed of *Microcoleus vaginatus* (a cyanobacteria). Lichens (*Collema* spp.) and mosses (*Tortula* spp.) are also common. Landscapes in which cyanobacteria predominate have a “pinnacle-type” microtopography created by soil heaving in response to winter freezing. Pinnacled crusts may reach heights of 4 in. (10 cm). Soil crusts play an important ecological role within an ecosystem (e.g., carbon and nitrogen fixation, solar energy absorption, and seed germination), and their presence can affect water infiltration rates and stabilize soil surfaces against wind and water erosion. Biological soil crusts are highly susceptible to compressional disturbance (from vehicles and trampling by animals or people), especially in sandy soils. Disturbance can affect their composition and may reduce the number and diversity of crust organisms found on the surface. In areas where biological crusts are abundant, these changes may increase the rate of soil loss due to surface runoff or wind erosion (USGS Canyonlands Research Station 2006; Belnap et al. 2001; Rosentreter et al. 2007). Biological soil crusts within the lease tracts have not been surveyed.

3.3.2.1 Gateway Lease Tracts

Soils within the Gateway lease tracts on Calamity and Outlaw Mesas (26 and 27) are predominantly the clay to gravelly loams of the following complexes: Bodot-Sili-rock outcrop (5 to 25% slopes); Gladel-Bond-rock outcrop (3 to 25% slopes); Wrayha-Dollard-Fergus (25 to 65% slopes); and Fergus-Zoltay (3 to 12% slopes). Together these complexes make up about 55% of the soil coverage at the two lease tracts (Figure 3.3-11). Rock outcrops (50–99% slopes) occur along the mesa rims (Map Unit 904) and cover about 27% of the two lease tracts. Soils on the mesa tops are formed from residuum weathered from clayey shale and sandstone. They are moderately deep to very deep and well-drained with slow to moderate infiltration rates when wet and slow to moderate rates of water transmission. Strewn cobbles, stones, and boulders

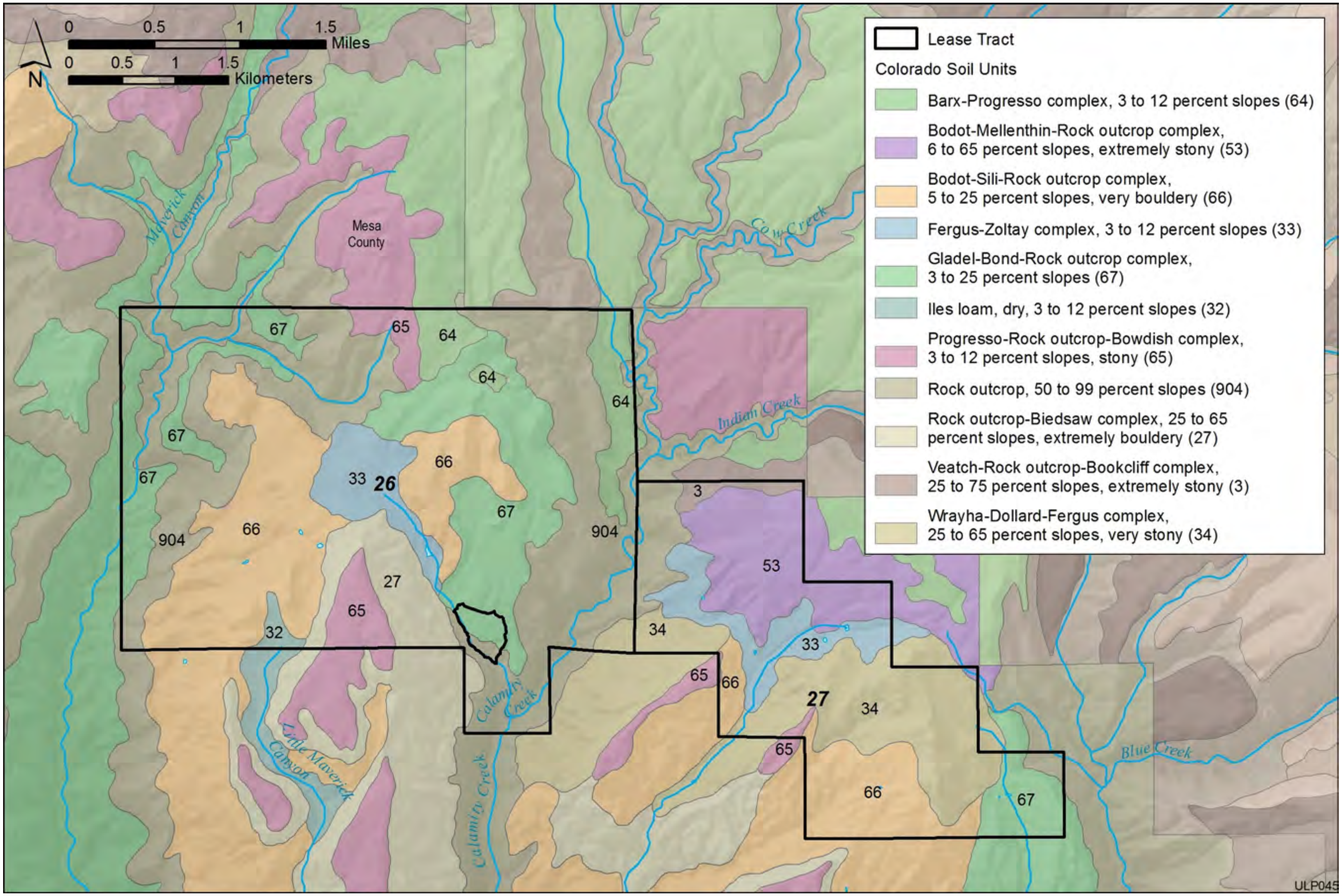

FIGURE 3.3-11 Soils within and around the Gateway Lease Tracts (NRCS 2009)

are common on the surface. Available water-holding capacity[12] is high for soils like the Fergus-Zoltay and Barx-Progresso complexes (Map Units 33 and 64), which have a relatively high organic content (NRCS 2012a).

Water erosion potential for mesa top soils is moderate (Kw factors range from 0.20 to 0.32),[13] with the highest potential occurring for soils of the Gladel-Bond-Rock outcrop complex on the slopes of Maverick Canyon on the west side of Lease Tract 26 (Map Unit 67). The susceptibility to wind erosion is low to moderate (wind erodibility groups [WEGs] 3 to 8),[14] but could be high in areas where vegetation is sparse. Soils on the mesa tops have a moderate to severe rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012a).

3.3.2.2 Uravan Lease Tracts

Soils within the Uravan lease tracts on Atkinson and Spring Creek Mesas (18, 19, 19A, and 20) are predominantly the loams and fine sandy loams of the Piñon-Bowdish-Rock outcrop (330% slopes) and the Barx-Progresso (3–12% slopes) complexes, which together make up about 74% of the soil coverage at the four lease tracts (Figure 3.3-12). The Rock outcrop-Orthents complex (40–90% slopes) occurs along the south rim of Atkinson Mesa and (Map Unit 88) and the southwest aspect of Spring Creek Mesa; below this complex (i.e., further downslope on terraces of the San Miguel River) is the Bodot, dry-Ustic Torriorthents complex (5–50% slopes) (Map Unit 23). These units together cover about 24% of the four sites. To the south, within the lease tracts on Club Mesa (24 and 25), the cobbly clay loams of the Bodot, dry-

[12] Available water-holding capacity is the amount of water that a soil can store that is available for use by plants. In this report it is expressed in relative terms (or classes) of low, medium, and high. The capacity of soil to hold water is affected by various soil characteristics, including texture and the amount of rock fragments and organic matter present. Loams (followed by clays) tend to have higher water-holding capacity than sands; rock fragments in soil decrease its water-holding capacity while organic matter increases it (NRCS 2012h).

[13] K factor is the soil erodibility factor, one of six factors used in the Universal Soil Loss Equation and the Revised Universal Soil Loss Equation to predict average annual rate of soil loss by sheet and rill erosion in tons per acre per year. Values range from 0.02 to 0.69. Other factors being equal, the higher the K value, the more susceptible the soil is to sheet and rill erosion by water. The ratings provided in this section are defined as follows: low, 0.02 to 0.19; moderate, 0.20 to 0.49; and high, 0.50 to 0.69. The values are based on the percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity and also takes into account the presence of rock fragments. For this reason, it is referred to here as K factor, whole soil (or Kw) (NRCS 2012b).

[14] WEGs are based on soil texture, organic matter content, effervescence of carbonates, content of rock fragments, and mineralogy, and also take into account soil moisture, surface cover, soil surface roughness, wind velocity and direction, and the length of unsheltered distance (USDA 2004). WEG groups range in value from 1 (most susceptible to wind erosion) to 8 (least susceptible to wind erosion). The NRCS provides a wind erodibility index, expressed as an erosion rate in tons per acre per year, for each of the WEGs: WEG 1, 160 to 310 tons/acre/year; WEG 2, 134 tons/acre/year; WEGs 3, 4 and 4L, 86 tons/acre/year; WEG 5, 56 tons/acre/year; WEG 6, 48 tons/acre/year; WEG 7, 38 tons/acre/year; and WEG 8, 0 tons/acre/year. The ratings provided in this section are defined as follows: low, WEGs 7 and 8; moderate, WEGs 3 to 6; and high, WEGs 1 and 2.

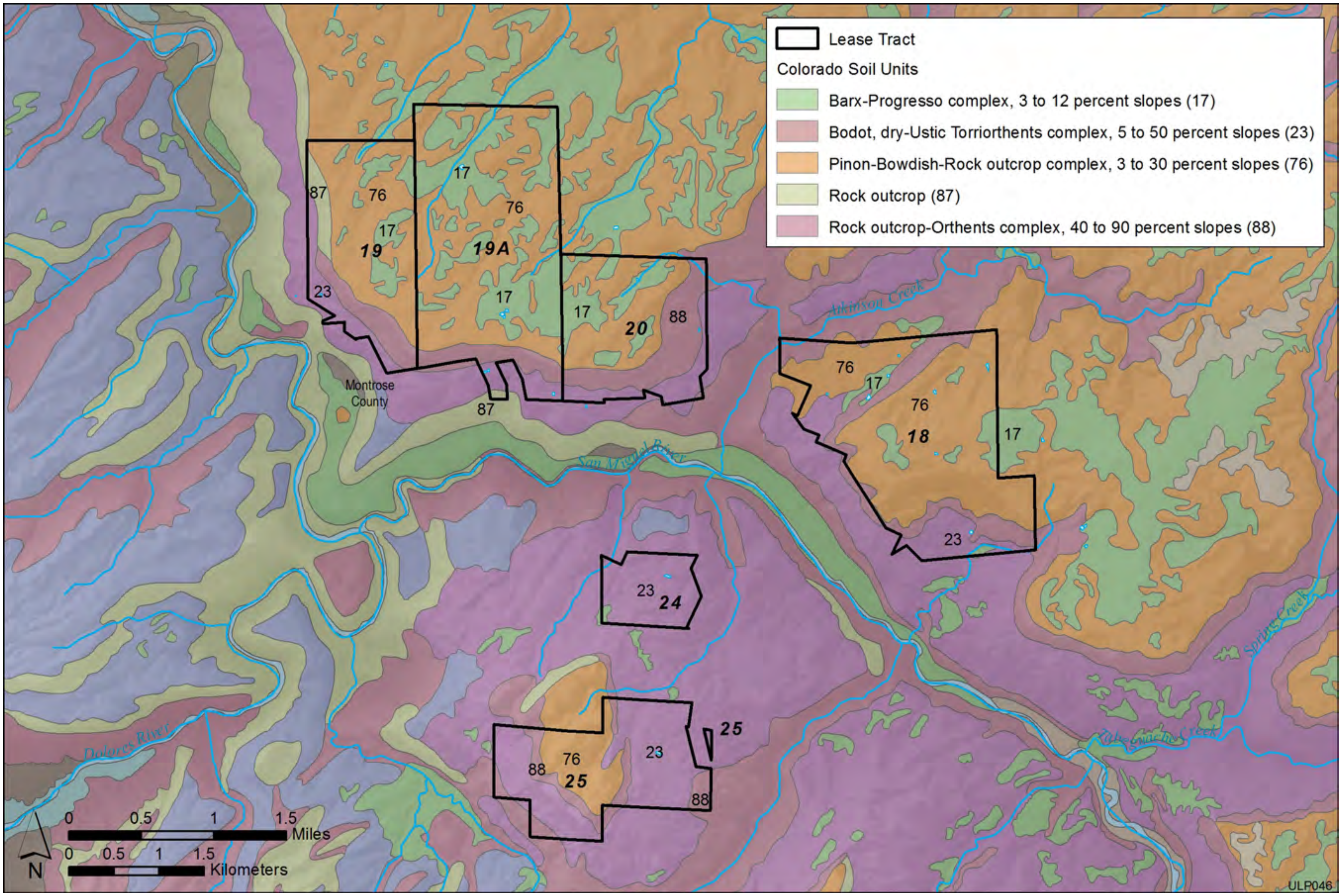

FIGURE 3.3-12 Soils within and around the Uravan Lease Tracts (NRCS 2009)

Ustic Torriorthents complex (5–50% slopes) predominate, constituting about 68% of the soil coverage at the two lease tracts.

Soils on the Atkinson and Spring Creek Mesas are formed from residuum weathered from interbedded sandstone and shale (Piñon-Bowdish-Rock outcrop complex) and from alluvium derived from sandstone exposed along drainages (Barx-Progresso complex). The soils of the Piñon-Bowdish-Rock outcrop complex are moderately deep and well-drained with very slow infiltration rates (i.e., very high surface runoff) when wet and slow to very slow rates of water transmission. Available water-holding capacity is very low. In contrast, soils of the Barx-Progresso complex have moderate infiltration rates when wet and moderate rates of water transmission; available water-holding capacity of these soils is high (NRCS 2012b).

Water erosion potential for soils on Atkinson and Spring Creek Mesas is moderate (Kw factor for the Barx-Progresso complex is 0.20; the Piñon-Bowdish-Rock outcrop complex is not rated). The susceptibility to wind erosion is also moderate (WEGs 3 and 4L) but could be high in areas where vegetation is sparse. Soils on the mesa tops have a moderate to severe rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012b).

Soils on Club Mesa are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents complex; Map Unit 23). These soils are moderately deep and well drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for soils on the mesa is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. Soils on the mesa top have a moderate rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012b).

3.3.2.3 Paradox Lease Tracts

3.3.2.3.1 Long Park Area. Soils within the Long Park area Lease Tracts 21, 22, and 22A are predominantly the cobbly clay loams of the Bodot, dry-Ustic Torriorthents complex (5–50% slopes), which makes up about 47% of the soil coverage at the three lease tracts (Figure 3.3-13). The Paradox fine sandy loam (Map Unit 73) covers portions of intermittent stream valleys that cut the plateau surface (streams flow to the northeast toward the San Miguel River), especially within Lease Tracts 21 and 22. Soils in lease tracts to the southeast (23-1, 23-2, and 23-3) occupy high-elevation areas cut by intermittent streams. Soils in the high-elevation areas are the loams of the Piñon-Bowdish-rock outcrop complex (3 to 30%); those in the valleys are the cobbly clay loams of the Bodot, dry-Ustic Torriorthents complex (5 to 50% slopes) (NRCS 2012c).

Soils in the high-elevation areas are formed from residuum weathered from interbedded sandstone and shale (Piñon-Bowdish-rock outcrop complex; Map Unit 75). These soils are moderately deep and well-drained with very slow infiltration rates (i.e., very high surface runoff)

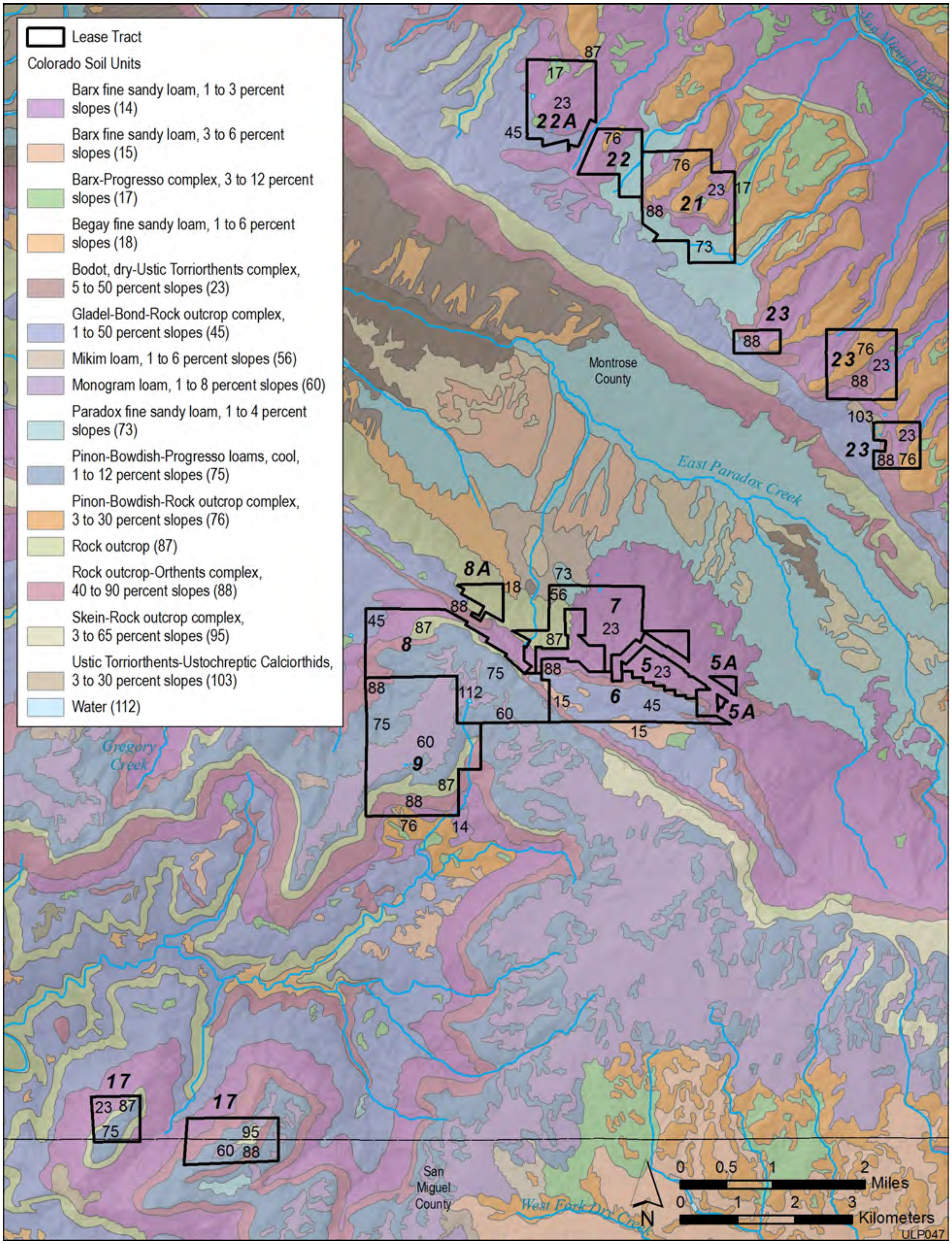

FIGURE 3.3-13 Soils within and around the Paradox Lease Tracts (NRCS 2009)

when wet and slow to very slow rates of water transmission. Available water-holding capacity is very low. Water erosion potential for high-elevation soils is not rated. The susceptibility to wind erosion is moderate (WEG 4L) but could be high in areas where vegetation is sparse. High-elevation soils have a moderate to severe rutting hazard (NRCS 2012c).

Soils in the intermittent stream valleys are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents; Map Unit 23). These soils are moderately deep and well-drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for stream valley soils is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. These soils have a moderate rutting hazard (NRCS 2012c).

Of all the soils in the Long Park area, only the Paradox fine sandy loam (Map Unit 73) is classified as prime farmland, if irrigated (NRCS 2012c).

3.3.2.3.2 Monogram Mesa Area. Soils within the lease tracts on top of and along the northeast aspect of Monogram Mesa (5, 5A, 6, 7, 8, 8A, and 9) have compositions that vary with elevation (Figure 3.3-13). On the top of the mesa (within Lease Tracts 8 and 9), soils are predominantly loams: the Piñon-Bowdish-Progresso loams, cool (1–12% slopes) and the Monogram loam (1–8% slopes), which together make up about 68% of the soil coverage at the two lease tracts. Lease Tract 8A sits almost exclusively on sandstone outcrops (Map Unit 87) along the mesa side slopes where soil is not well developed. Soils within the remaining lease tracts occur at lower elevations, along the mesa side slopes (Lease Tract 6) where the Gladel-Bond-Rock outcrop complex (1–50% slopes) predominates, covering about 63% of the site, and along the lower terraces above the southeast end of Paradox Valley (5, 5A, and 7) where the Bodot, dry-Ustic Torriorthents complex (5–50% slopes) predominates, covering about 78% of the three lease tracts (NRCS 2012d).

Soils on the mesa top are formed from residuum weathered from interbedded sandstone and shale and from windblown (eolian) deposits (Monogram loam) over sandstone. They are moderately deep to deep and well-drained with slow to moderate infiltration rates when wet and slow to moderate rates of water transmission. Available water-holding capacity is very low (Piñon-Bowdish-Progresso loams) to high (Monogram loam). Water erosion potential for mesa top soils is moderate (Kw factors range from 0.32 to 0.43), with the highest potential occurring for the Monogram loam on Lease Tract 9 (Map Unit 60). The susceptibility to wind erosion is also moderate (WEGs 4L and 6) but could be high in areas where vegetation is sparse. These soils are not rated for rutting hazard. Only the Monogram loam is classified as prime farmland, if irrigated (NRCS 2012d).

Soils on the mesa side slopes are formed from residuum and eolian material weathered from sandstone (Gladel-Bond-Rock outcrop complex; Map Unit 45). These soils are very shallow to shallow and well-drained with very slow infiltration rates (i.e., very high surface runoff) when wet and very slow rates of water transmission. Available water-holding capacity is very low. Water erosion potential for soils on the mesa side slopes is moderate (Kw factor is 0.20). The susceptibility to wind erosion is also moderate (WEG 3) but could be high in areas where vegetation is sparse. These soils are not rated for rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012d).

Soils on the lower terraces above Paradox valley are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents complex; Map Unit 23). These soils are moderately deep and well-drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for mesa top soils is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. These soils have a moderate rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012d).

3.3.2.3.3 Wedding Bell and Radium Mountains. Soils within the lease tracts on top of Wedding Bell and Radium Mountains (17-1 and 17-2) are predominantly the fine sandy loams of the Piñon-Bowdish-Rock outcrop (3 to 30% slopes), which make up about 40% of the soil coverage at the two lease tracts (Figure 3.3-13). The mountain tops are rimmed by rock outcrops, including the Rock outcrop-Orthents complex (Map Units 87 and 88), covering about 29% of the sites. Soils at lower elevations (e.g., toward Bachelor Draw that separates the two landforms) are composed of the cobbly clay loams of the Bodot, dry-Ustic Torriorthents complex (5–50% slopes) (NRCS 2012d).

The soils on the mountain tops are formed from residuum weathered from interbedded sandstone and shale (Piñon-Bowdish-Progresso loams; Map Unit 76). They are moderately deep and well-drained with very slow infiltration rates (i.e., very high surface runoff) when wet and slow to very slow rates of water transmission. Available water-holding capacity is very low. Water erosion potential for mountain top soils is moderate (Kw factor is 0.32). The susceptibility to wind erosion is also moderate (WEG 4L) but could be high in areas where vegetation is sparse. These soils are not rated for rutting hazard. Except for the Monogram loam, which occurs on Lease Tract 17-1, none of the soils are classified as prime or unique farmland (NRCS 2012d).

Soils at lower elevations are formed from slope alluvium weathered from shale (Bodot, dry-Ustic Torriorthents complex; Map Unit 23). These soils are moderately deep and well-drained with slow infiltration rates (i.e., high surface runoff) when wet and slow rates of water transmission (smectitic properties impede the movement of water). Available water-holding capacity is low. Water erosion potential for these soils is low (Kw factor is 0.10). The susceptibility to wind erosion is moderate (WEG 5) but could be high in areas where vegetation is sparse. Soils at lower elevations have a moderate rutting hazard. None of the soils are classified as prime or unique farmland (NRCS 2012d).

3.3.2.4 Slick Rock Lease Tracts

Soils within the Slick Rock lease tracts can be divided regionally into those that occur on the flanks of Summit Canyon (11, 11A, 16, and 16A), those that occur in Dolores River Canyon (13, 13A, and 14), those that sit on a topographic bench above the Dolores River (15 and 15A), and those that sit on hill slopes to the south of Slick Rock (10 and 12). Soils along Summit Canyon and on the topographic bench above the Dolores River are similar in composition and characteristics to those previously described that form on mesa tops (see Sections 3.3.2.1 and 3.3.2.2; NRCS 2012e, f). They are predominantly Piñon-Bowdish-Progress loams, cool (1–12% slopes) and the sandy loams of the Gladel-Bond-rock outcrop (1–50% slopes) and the Gladel-Bond-rock outcrop, cool (3–25% slopes) complexes; sandstone outcrops (Map Unit 87), where soil is not well developed, are also common along the canyon walls (Figure 3.3-13).

Soils within lease tracts along the Dolores River Canyon (13, 13A, and 14) are predominantly the sandy and stony loams of the Farb-Rock outcrop (1–30% slopes) and Rock outcrop-Orthents (40–90% slopes) complexes, which together make up about 63% of the soil coverage at the three lease tracts (Figure 3.3-14). Soils of the Farb-Rock outcrop complex formed in residuum weathered from sandstone; soils of the Rock outcrop-Orthents complex formed from colluvium and slope alluvium weathered from sandstone and shale. The soils are shallow and well to excessively drained with a very slow infiltration rates (i.e., very high surface runoff) when wet. Available water-holding capacity is very low for most soils within the three lease tracts. Water erosion potential is moderate (Kw factors range from 0.20 to 0.49; the Farb-Rock outcrop complex is not rated), with the highest potential occurring for the Killpack-Deaver loams (Map Unit 52) on the high-elevation slopes along the Dolores River. The susceptibility to wind erosion is low to moderate (WEGs 3 to 8). Soils in the canyon bottom (Fluvaquents; Map Unit 43) are poorly drained and prone to flooding. These soils cover only a small portion of the site (about 3%) and have a moderate water erosion potential (Kw factor 0.37) (NRCS 2012e).

Soils within Lease Tract 10 are predominately the very stony loams of the Borolls-Rock outcrop complex (40 to 90% slopes) and the Beje fine sandy loam (3 to 25% slopes), which together make up about 74% of the soil coverage at the site (Figure 3.3-14). Soils of the Borolls-Rock outcrop complex formed from colluvium and residuum weathered from sandstone and shale; Beje fine sandy loams formed from residuum weathered from sandstone. The soils are shallow and well=drained with very slow infiltration rates (i.e., very high surface runoff) when wet and slow to very slow rates of water transmission; the Borolls-Rock outcrop complex is characterized by a more moderate infiltration rate. Available water-holding capacity is low to very low. Water erosion potential for soils within the lease tract is moderate (Kw factor is 0.24). The susceptibility to wind erosion is also moderate (WEG 6) but could be high in localized areas where vegetation is sparse. None of the soils are classified as prime or unique farmland (NRCS 2012f).

Soils within Lease Tract 12 are predominantly the Nortez loam (1 to 6% slopes), the Nortez-Fivepine loams (1 to 12% slopes), and the Nortez-Acree loams (1 to 12% slopes), which together make up about 87% of the soil coverage at the site (Figure 3.3-14). These soils are formed from mixed alluvium derived from sandstone and shale. They are moderately deep and

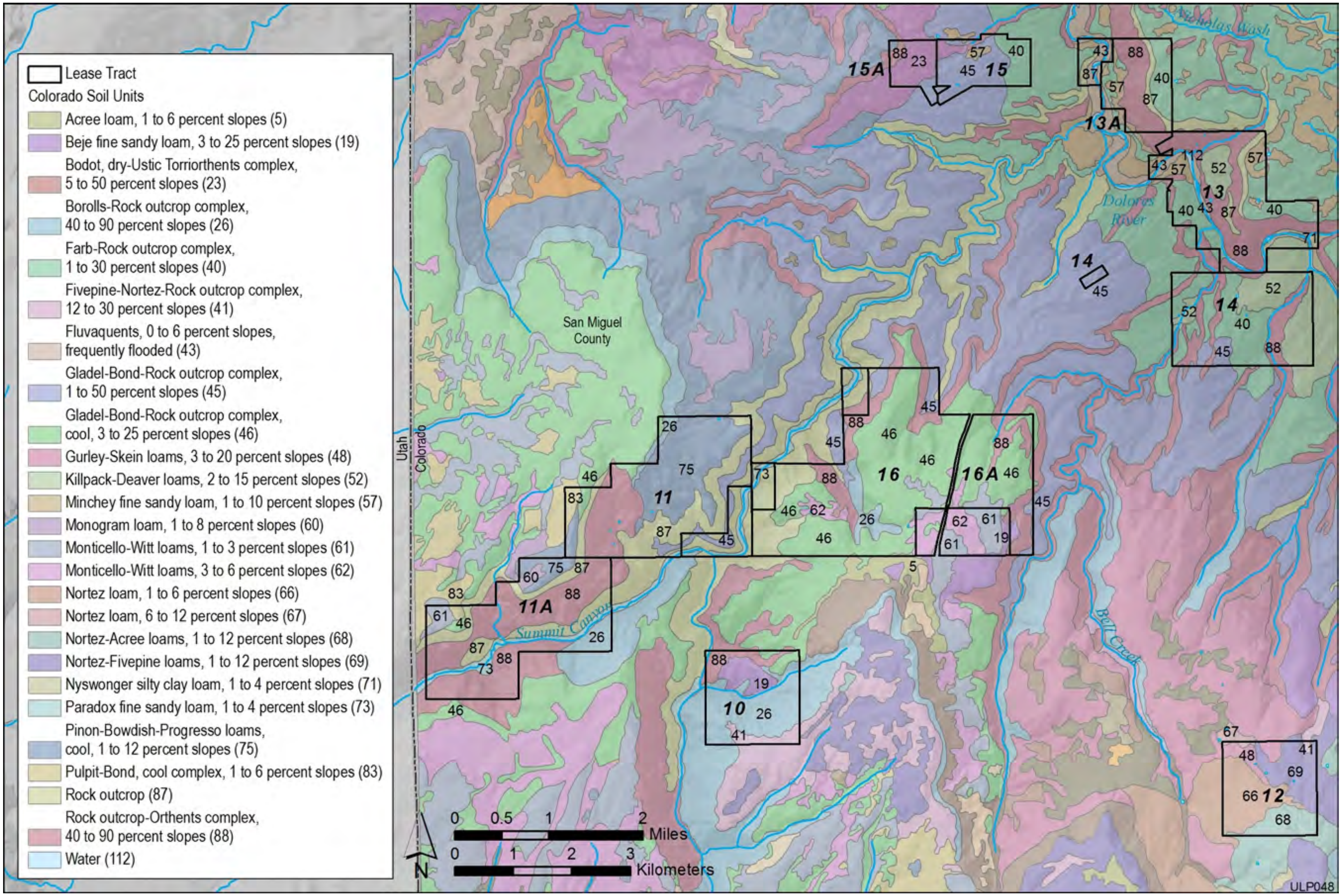

FIGURE 3.3-14 Soils within and around the Slick Rock Lease Tracts (NRCS 2009)

well-drained with a slow infiltration rate when wet. Available water-holding capacity is low to very low. Water erosion potential for soils within the lease tract is moderate (Kw factor is 0.32). The susceptibility to wind erosion is also moderate (WEG 6) but could be high in areas where vegetation is sparse. None of the soils are classified as prime or unique farmland (NRCS 2012g).

3.4 WATER RESOURCES

Water resources in southwestern Colorado are primarily governed by semiarid climate conditions and rugged topography. The DOE ULP tracts are located in the Colorado Plateaus physiographic region, which contains characteristic, high-elevation plateaus and vast canyon regions (USGS 2003). The lease tracts span the Upper Dolores (14030002), San Miguel (14030003), and Lower Dolores (14030004) hydrologic cataloging units (Hydrologic Unit Codes, HUC8), which cover a combined 4,600 mi^2 (12,000 km^2) in southwestern Colorado and portions of eastern Utah (USGS 2011a). The surficial geology of the region is described in Section 3.3. The climatic conditions of southwestern Colorado can vary over short distances because of the mountainous terrain; they can be generally characterized as having cold winters with snow cover and high summer temperatures (WRCC 2011b). Average annual precipitation patterns are relatively high in the Mountain area, with decreasing precipitation heading west across the study area, as shown in Figure 3.4-1. Monthly precipitation and snowfall amounts have been recorded at Uravan, Colorado (NOAA CO-OP ID 58560; NCDC 2012) since 1960. Average monthly precipitation totals range from 0.5 to 1.5 in. (1.3 to 3.8 cm), and snowfall occurs between October and April, with monthly totals averaging 0.2 to 4.2 in. (0.5 to 10.7 cm), but with maximum monthly snowfalls exceeding 30 in. (76 cm). The average annual precipitation at Uravan was 12.5 in. (31.8 cm), with a range of 7.1 to 21.4 in (18.0 to 54.4 cm) from 1960 to 2012. The potential annual evaporation rate is estimated to be 38 in. (97 cm) by Golder Associates (2009), based on the climate data at the Uravan station. The soil water content is usually deficient, and direct groundwater recharge is thus minimal under the condition of low annual precipitation and the high potential for evaporation in the area.

3.4.1 Surface Water

3.4.1.1 Stream and Drainage Systems

The Dolores River and its tributary, the San Miguel River, are the main perennial rivers that flow through the lease tracts, as shown in Figure 3.4-2. The Gunnison River flows into the Colorado River near Grand Junction, Colorado, but it is on the order of 50 mi (80 km) northeast of the lease tracts and separated by a drainage divide. The Dolores River Basin includes three watersheds, Upper Dolores, San Miguel, and Lower Dolores, which are drained by the Dolores and San Miguel Rivers and their tributaries, as well as numerous intermittent and ephemeral streams.

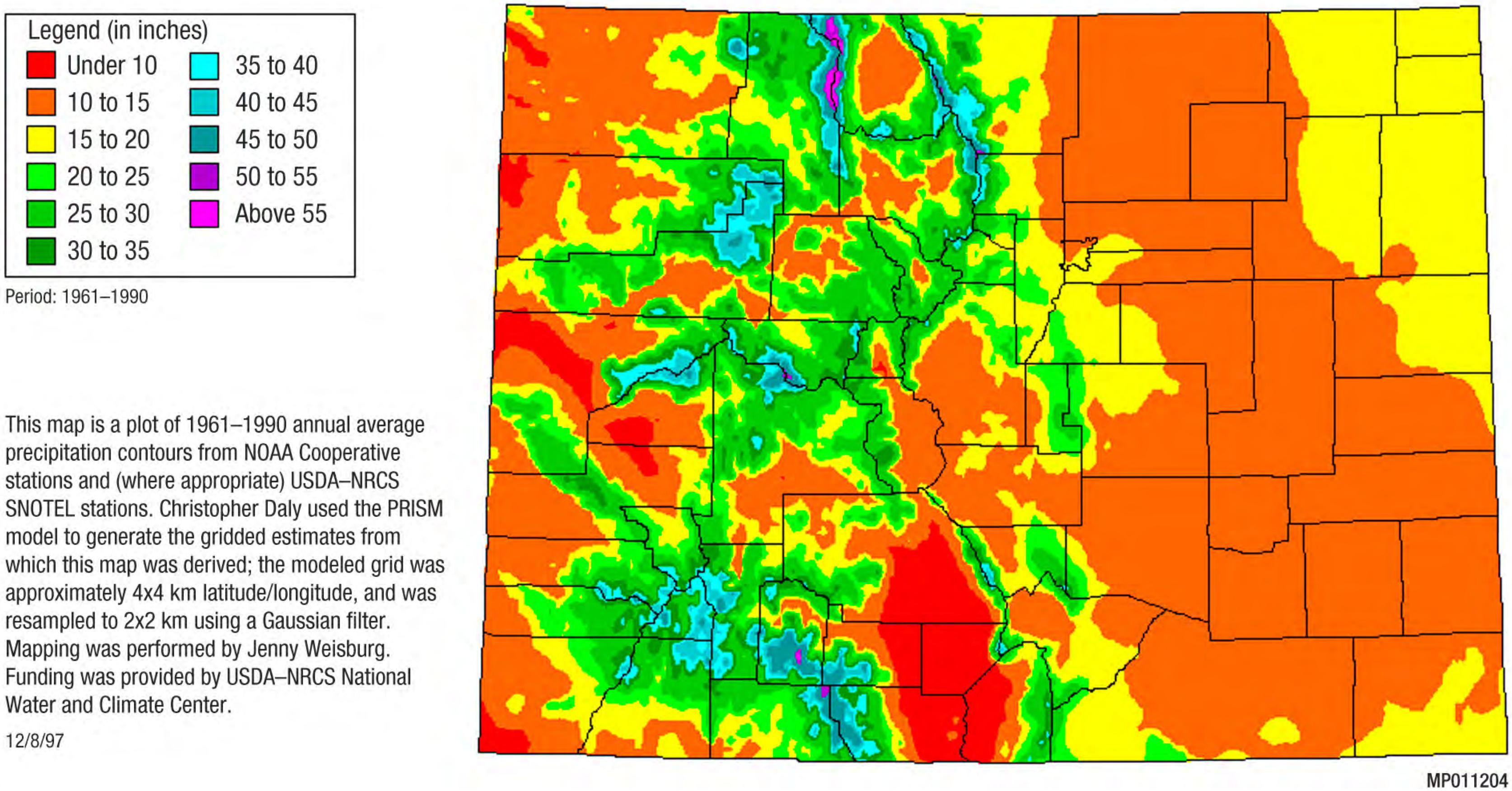

FIGURE 3.4-1 Average Annual Precipitation in Colorado, 1961–1990 (WRCC 1997)

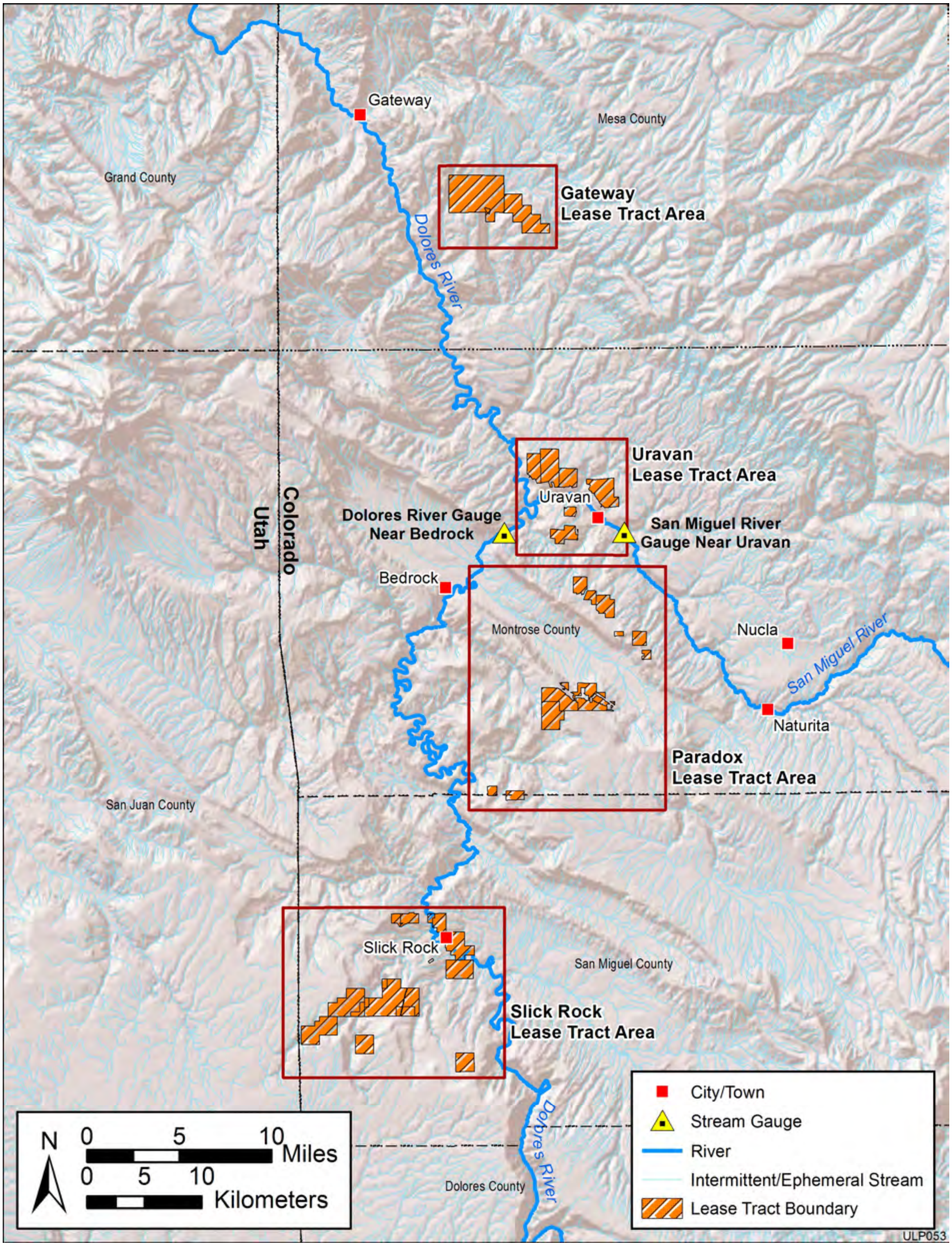

FIGURE 3.4-2 Map of Surface Water Features in the Region of the DOE ULP Lease Tracts

The Dolores and San Miguel Rivers originate in the Rico, La Plata, and San Juan Mountains of southwest Colorado, with topographic elevations ranging from 14,200 ft (4,300 m) near the Dolores River headwaters to 4,100 ft (1,250 m) at their combined confluence with the Colorado River near the Colorado–Utah border. The Dolores River flows north and northwest through the Slick Rock lease tract and flows northeast adjacent to the Uravan lease tract near its confluence with the San Miguel River, which flows through the Uravan region. The Dolores River and San Miguel River flow primarily through canyons, with the exception being in low-relief alluvial regions of Paradox Valley that are crossed by the Dolores River. Several ephemeral streams drain the uranium lease tracts and eventually reach the Dolores River and the San Miguel River (Figure 3.4-2).

The Dolores River reach that flows through the lease tracts is regulated by the McPhee Dam and reservoir located upstream of the lease tracts in Montezuma County, Colorado. The McPhee Dam was constructed in 1984, and its reservoir was filled by 1987 as a part of the Dolores Project for irrigation and water supply (BOR 2009). Downstream of McPhee Dam, flow in the Dolores River is affected by reservoir releases and runoff in the surrounding watershed. Surface runoff below McPhee Dam was estimated to be 2.5 in./yr (64 mm/yr), representing 15% of the precipitation in this region (Weir et al. 1983). Flow in the San Miguel River is largely unregulated except for some water extractions and is primarily controlled by snowmelt in the spring and heavy, short-duration rains in the late summer (Allred and Andrews 2000). Surface runoff in the lower part of the San Miguel River watershed was estimated to range between 2.4 and 9.8 in./yr (60 and 250 mm/yr) (Ackerman and Rush 1984).

Both the Dolores and San Miguel Rivers have large seasonal fluctuations in flow, with high runoff in spring and low flow in winter (Figures 3.4-3 and 3.4-4). Flows are largest during the snowmelt period of April through June each year, with daily averaged discharges ranging between 1,000 and 3,500 ft^3/s (28 and 99 m^3/s) in the Dolores River near Bedrock (USGS Gage 09171100), and between 500 and 2,000 ft^3/s (14 and 57 m^3/s) in the San Miguel River near Uravan (USGS Gage 09177000). Instantaneous peak discharges can often exceed daily averaged discharge records, and historical peak discharges in the Dolores River near Bedrock, Colorado (USGS Gages 09169500 and 09171100) ranged between 1,300 and 10,000 ft^3/s (37 and 280 m^3/s) before the McPhee Dam was built in the mid-1980s, and between 500 and 5,400 ft^3/s (14 and 150 m^3/s) after the dam was built (USGS 2011b). Discharge in the Dolores River typically increases as it flows downstream as a result of groundwater discharge (Weir et al. 1983), with the exception being as the river flows through Paradox Valley, where groundwater extraction associated with the Paradox Valley Unit (BOR) reduces river flow (Golder Associates 2009). Discharge in the San Miguel River typically increases as it moves downstream, with localized regions that lose flow to groundwater recharge (Ackerman and Rush 1984). Peak discharges in the San Miguel River near Uravan, Colorado (USGS Gage 09177000) occurred throughout the spring, summer, and fall between 1954 and 2010 and ranged between 1,000 and 9,000 ft^3/s (28 and 260 m^3/s) (USGS 2011b).

Intermittent and ephemeral streams, which primarily flow in response to seasonal snowmelt and precipitation events, occur throughout many of the lease tracts. More than 150 intermittent and ephemeral stream segments occur within the DOE ULP lease tracts

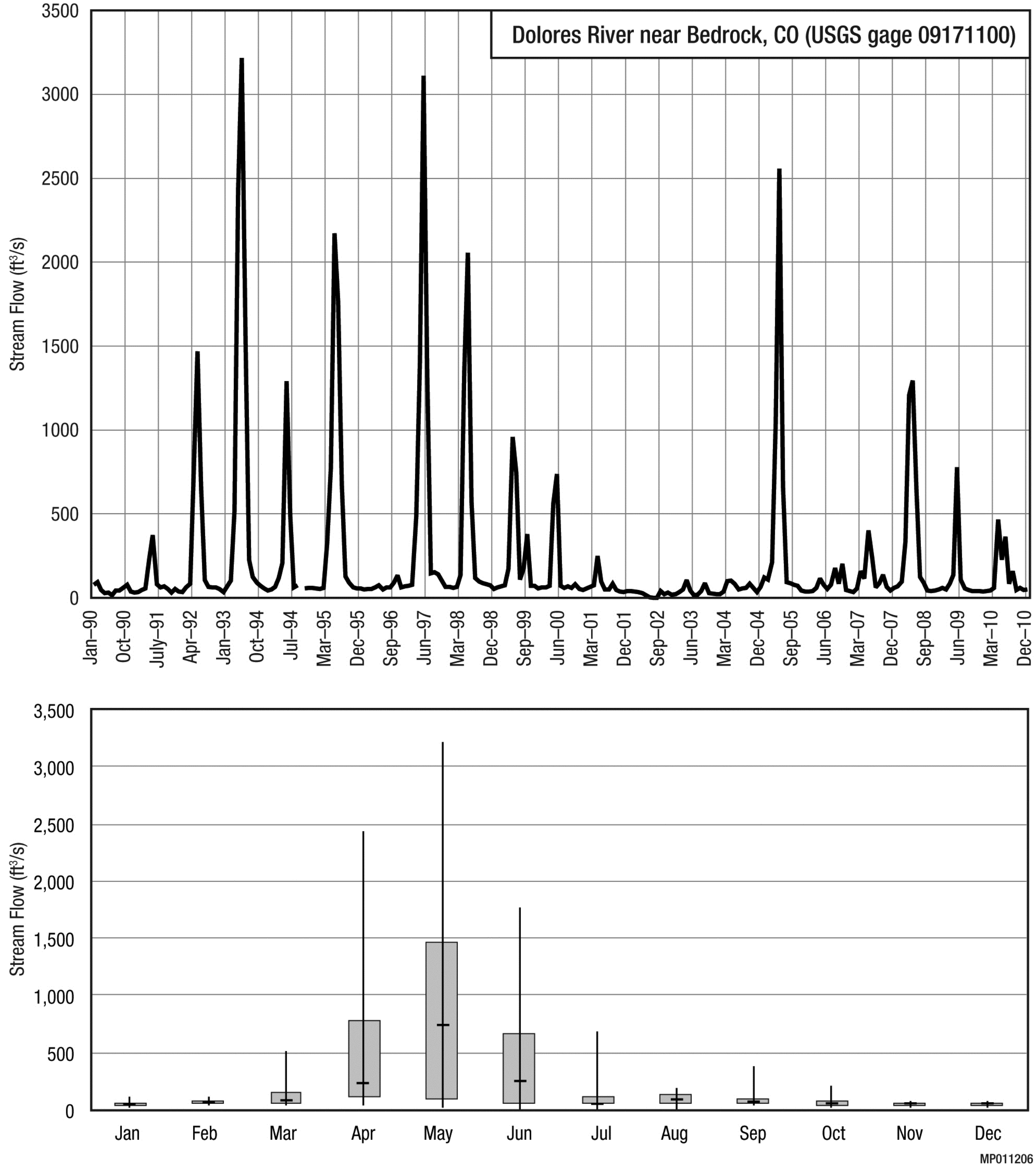

FIGURE 3.4-3 Seasonal Hydrograph and Monthly Discharge Values in the Dolores River near Bedrock, Colorado (USGS Gage 09171100), 1990–2010 (Top shows seasonal hydrographs; bottom shows monthly percentile; 50% = tick mark; 25% and 75% = grey box; minimum and maximum values = vertical line)

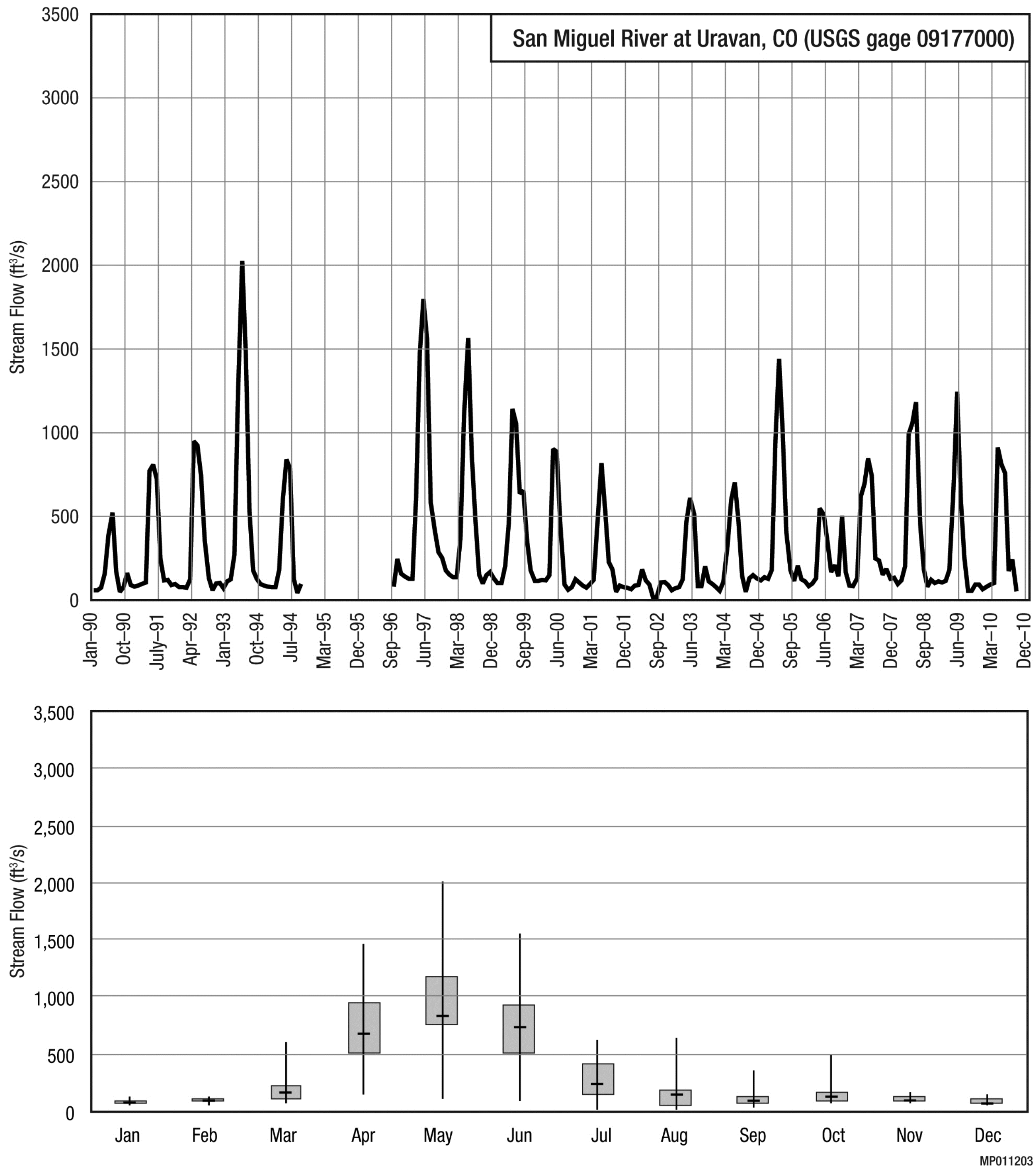

FIGURE 3.4-4 Seasonal Hydrograph and Monthly Discharge Values in the San Miguel River near Uravan, Colorado (USGS Gage 09177000), 1990–2010 (Top shows seasonal hydrographs; bottom shows monthly percentile; 50% = tick mark; 25% and 75% = grey box; minimum and maximum values = vertical line)

(Figure 3.4-2). Total intermittent and ephemeral stream channel lengths within each lease tract are 18 mi (29 km) in Gateway, 11 mi (18 km) in Uravan, 9 mi (14 km) in Paradox, and 20 mi (32 km) in Slick Rock. Peak discharges in these intermittent and ephemeral stream channels have been reported to vary from 2 to 5,660 ft^3/s (0.06 to 160 m^3/s), as shown in Table 3.4-1. Precipitation and snowmelt runoff conveyed overland, primarily in intermittent and ephemeral streams within the Dolores River basin, was estimated to be as high as 270 million m^3/yr (Weir et al. 1983).

3.4.1.2 Existing Water Quality

Section 303(d) of the Clean Water Act (CWA), as amended, requires states to develop lists of water bodies that do not meet water quality standards and to submit updated lists to the EPA every two years, along with the integrated report on water quality conditions that is required in Section 305(b). The latest Colorado 305(b) report and 303(d) list were issued in April 2012 by the CDPHE Water Quality Control Division, covering the 2010–2011 two-year period.

In the current listing cycle (2012), more than 71,048 river miles and more than 151,827 lake acres in Colorado were assessed, and their attainment status was determined according to five reporting categories (CDPHE 2012a). Stream segments or reservoirs that are not attaining their classified water uses (Category 5) are defined as impaired and placed in the 303(d) list, which requires development of the total maximum daily load (TMDL) to correct impairment. If water bodies are suspected to be impaired but there are not enough data to address the uncertainties, CDPHE places them on the Monitoring and Evaluation (M&E) List to collect more data. The results of CDPHE's assessment in the 2012 reporting cycle represent a current understanding of the existing water quality for Colorado water bodies. All water bodies in the

TABLE 3.4-1 Range in Reported Peak Discharge Values for Intermittent and Ephemeral Streams in the Region of the DOE ULP Lease Tracts

Stream	USGS Gage	Peak Discharge (ft^3/s)
Disappointment Creek Tributary near Slick Rock, CO	9168700	36–260
East Paradox Creek Tributary near Bedrock, CO	9169800	26–368
West Paradox Creek near Bedrock, CO	9171000	16–5,200
West Paradox Creek near Paradox, CO	9170500	18–678
Cottonwood Creek near Nucla, CO	9174500	32–321
Dead Horse Creek near Naturita, CO	9175800	10–1,250
Dry Creek near Naturita, CO	9175900	290–5,660
Tabeguache Creek near Nucla, CO	9176500	114–303
Deep Creek near Paradox, CO	9178000	2–22
Salt Creek near Gateway, CO	9179200	25–2,670
Taylor Creek near Gateway, CO	9177500	13–555
West Creek Tributary near Gateway, CO	9179400	19–277

2012 303(d) and M&E lists, within the three watersheds (Upper Dolores, San Miguel, and Lower Dolores) that encompass the lease tracts, are presented in Table 3.4-2. The locations of the impaired water bodies are shown in Figure 3.4-5.

In the Upper Dolores watershed (HUC8: 14030002), impaired water was identified in McPhee Reservoir (located upstream of the lease tracts) because of elevated mercury concentration in fish tissues and in Silver Creek, a tributary to the Dolores River (upstream of McPhee Reservoir), for non-attainment of dissolved cadmium and zinc standards. The McPhee Reservoir has been on the 303(d) list since 1998 and ranked as high priority, requiring development of the TMDL to reduce the mercury concentration (Table 3.4-2). Phase I of TMDL development has been completed by CDPHE. The main suspected sources of mercury in the reservoir include historic mining activities (i.e., hard rock mining), atmospheric deposition from nearby and distant sources, such as coal-based power plants, and naturally occurring background in local geologic formations and soils (CDPHE 2003). An estimated load reduction is 75% assigned to atmospheric deposition load and 50.8 % to loads from the former mining areas. The impaired Silver Creek is currently under implementation of the TMDL established in 2008 and has been removed from the 303(d) list. The high concentrations of cadmium and zinc are primarily the result of mining activity in the watershed between the1880s and the late 1970s (CDPHE 2008a). A range of monthly allowed TMDLs for cadmium and zinc is presented in Table 3.4-2. Along the downstream segment of the Dolores River within the Upper Dolores, the river water is found impaired for their nonattainment of iron standards. A TMDL assessment for the segment is required with a high priority. The sources of elevated iron in the river segment will be analyzed in the TMDL assessment. However, the previous USGS study indicates that iron is not typically enriched in water from the uranium mines in this area (Nash 2002). The Paradox and Uravan lease tract areas near the impaired segment are unlikely to be contributing to impairment. In addition, three stream segments are on the 2012 monitoring and evaluation (M&E) list for their excessive *E. coli* and selenium, requiring collection of more data.

In the San Miguel watershed (HUC8: 14030003), seven stream segments and one reservoir (located upstream of the lease tracts) were identified as being impaired for their depleted dissolved oxygen, elevated concentrations of cadmium and zinc, or non-attainment of the Colorado multi-metric index for aquatic life (Table 3.4-2). The impairment of Miramonte Reservoir and of Howard Fork and Maverick Draw, tributaries to the San Miguel River (located upstream of Naturita), resulted from excess nutrients, requiring further assessment and TMDL development. The impairment of the other five stream segments was identified as due to exceedance of cadmium and zinc standards. Among them, four segments are located in the San Miguel River headwaters, whose tributaries flow through historical mining areas near Telluride. In the 2012 listing cycle, TMDLs developed for these four stream segments were approved for implementation, and the segments were removed from the 2012 303(d) list. The TMDL assessment indicates that stream impairment is attributed to remnants of mining activities, such as tailings piles, abandoned tunnels, mining equipment, and mills generated from gold, silver, and lead mining from 1875 to 1978. These mining remnants have been exposed to infiltration and runoff, which leaches metals (cadmium and zinc) into surface water (CDPHE 2010). The established TMDLs provide a substantial reduction of loads, as shown in Table 3.4-2. In addition, 12 stream segments were identified as impaired with some uncertainties requiring

TABLE 3.4-2 Impaired Water Bodies on the Colorado 2012 303(d) and M&E Lists or in the Process of Implementing TMDL within the Upper Dolores, San Miguel, and Lower Dolores Watersheds

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
Upper Dolores (HUC-8 Basin: 14030002)						
COGULD03a	All tributaries to the Dolores River from the bridge at Bradfield Ranch to the Colorado/Utah border	Disappointment Creek	Selenium, *E. coli*			
COGULD04	Mainstem of West Paradox Creek from the source to the confluence with the Dolores River; mainstem and all tributaries to Blue Creek from the source to the confluence with the Dolores River	West Paradox Creek	*E. coli*, Iron (Trec)			
COSJDO04b	McPhee Reservoir and Summit Reservoir	McPhee Reservoir		Aquatic Life Use (mercury*in fish tissue)	High	
COSJDO09_743D	Silver Creek, from Rico's Diversion to Dolores River					Cadmium 0.0002–0.0013 lb/day; zinc: 0.091–0.377 lb/day (35101)
COSJDO11	All tributaries to Dolores River, from the confluence of the W. Dolores River, to bridge at Bradfield Ranch (Forest Rt. 505, near Montezuma/Dolores County Line	Lost Canyon Creek	*E. coli*			
COGULD02	Dolores River from Little Gypsum Valley bridge to Colorado–Utah border	Downstream of Upper Dolores	*E. coli*	Iron (Trec)	High	

TABLE 3.4-2 (Cont.)

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003)						
COGUSM02	Tributaries to the San Miguel River from the source to Leopard Creek	Bear Creek	Lead	Cadmium, zinc (sc)	High	
COGUSM02	Tributaries to the San Miguel River from the source to Leopard Creek	Cornet Creek	Lead			
COGUSM02	Tributaries to the San Miguel River from the source to Leopard Creek	Howard Fork above Swamp Canyon		pH, dissolved oxygen	High	
COGUSM03b	Mainstem of the San Miguel River Marshall Creek to South Fork San Miguel River	All	Lead			
COGUSM03B_7500	San Miguel River–Marshall Creek to South Fork San Miguel River					Cadmium 0.03–0.59 lb/day; zinc 2.6–108.9 lb/day (35252)
COGUSM04a	Mainstem of the San Miguel River from the South Fork of the San Miguel to below the CC ditch	From South Fork San Miguel to confluence with Leopard Creek	Lead			
COGUSM06a	Ingram Creek, source to San Miguel River	All	Manganese. copper			

TABLE 3.4-2 (Cont.)

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003) (Cont.)						
COGUSM06A_7500	Ingram Creek, mainstem of Ingram Creek including all tributaries					Cadmium 0.003 lb/day (38985)
COGUSM03A_7500	San Miguel River –Bridal Veil and Ingram Creek to Marshall					Zinc 4.1 lb/day (35251)
COGUSM06b	Marshall Creek, source to San Miguel River	All	Copper			
COGUSM06B_7500	Marshall Creek, mainstem of Marshall Creek including all tributaries, lakes, reservoirs, and wetlands from source to confluence with San Miguel River					Cadmium 0.003 lb/day; zinc 0.6–13.6 lb/day (38986)
COGUSM07a	Mainstem of Howard Fork and tributaries Swamp Gulch the South Fork of the San Miguel	Chapman Creek	Iron (Trec)			
COGUSM07a	Mainstem of Howard Fork and tributaries from a point immediately below the confluence of Swamp Gulch to its confluence with the South Fork of the San Miguel River	Iron Bog Creek	pH, dissolved oxygen			

TABLE 3.4-2 (Cont.)

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003) (Cont.)						
COGUSM08	Mainstem of South Fork of San Miguel River from the Howard and Lake Forks to the San Miguel River	All	Manganese (WS)			
COGUSM10	Mainstem of Naturita Creek from the Uncompahgre National Forest boundary to its confluence with the San Miguel River, and Gurley Reservoir; Tabeguache Creek from its source to the confluence with San Miguel River	Naturita Creek	Dissolved oxygen, *E. coli*			
COGUSM11	West Fork of Naturita Creek, Miramonte Reservoir, the mainstem of Beaver, Horsefly, and Saltado Creeks from the Uncompahgre National Forest boundary to their confluence with the San Miguel River	Miramonte Reservoir		Dissolved oxygen (temperature)	High	
COGUSM12	All tributaries to the San Miguel River from the confluence of Leopard Creek to the Dolores River	Mesa Creek	Selenium			

TABLE 3.4-2 (Cont.)

Water Body ID (WBID)	Segment Description	Portion	Colorado's Monitoring & Evaluation Parameter(s)	Clean Water Act Section 303(d) Impairment	303(d) Priority	Total Maximum Daily Load (ID)[a]
San Miguel (HUC-8 Basin: 14030003) (Cont.)						
COGUSM12	All tributaries to the San Miguel River from the confluence of Leopard Creek to the Dolores River	Calamity Draw, Specie Creek	Dissolved oxygen			
COGUSM12	All tributaries to the San Miguel River from the confluence of Leopard Creek to the Dolores River	Maverick Draw		Aquatic life (provisional)	Low	
Lower Dolores (HUC-8 Basin: 14030004)						
COGULD02	Dolores River from Little Gypsum Valley bridge to Colorado–Utah border	All	*E. coli*	Iron (Trec)	High	
COGULD05	Mainstem of West Creek from the source to the confluence with the Dolores River; Roc Creek; La Sal Creek and Mesa Creek from their sources to their confluences with Dolores River	Roc Creek	*E. coli*	Copper, iron (Trec)	High	

[a] If the TMDL varies with the monthly mean flow, a range of TMDL for 12 months is presented.

Sources: CDPHE (2008a,b, 2010, 2012a,b)

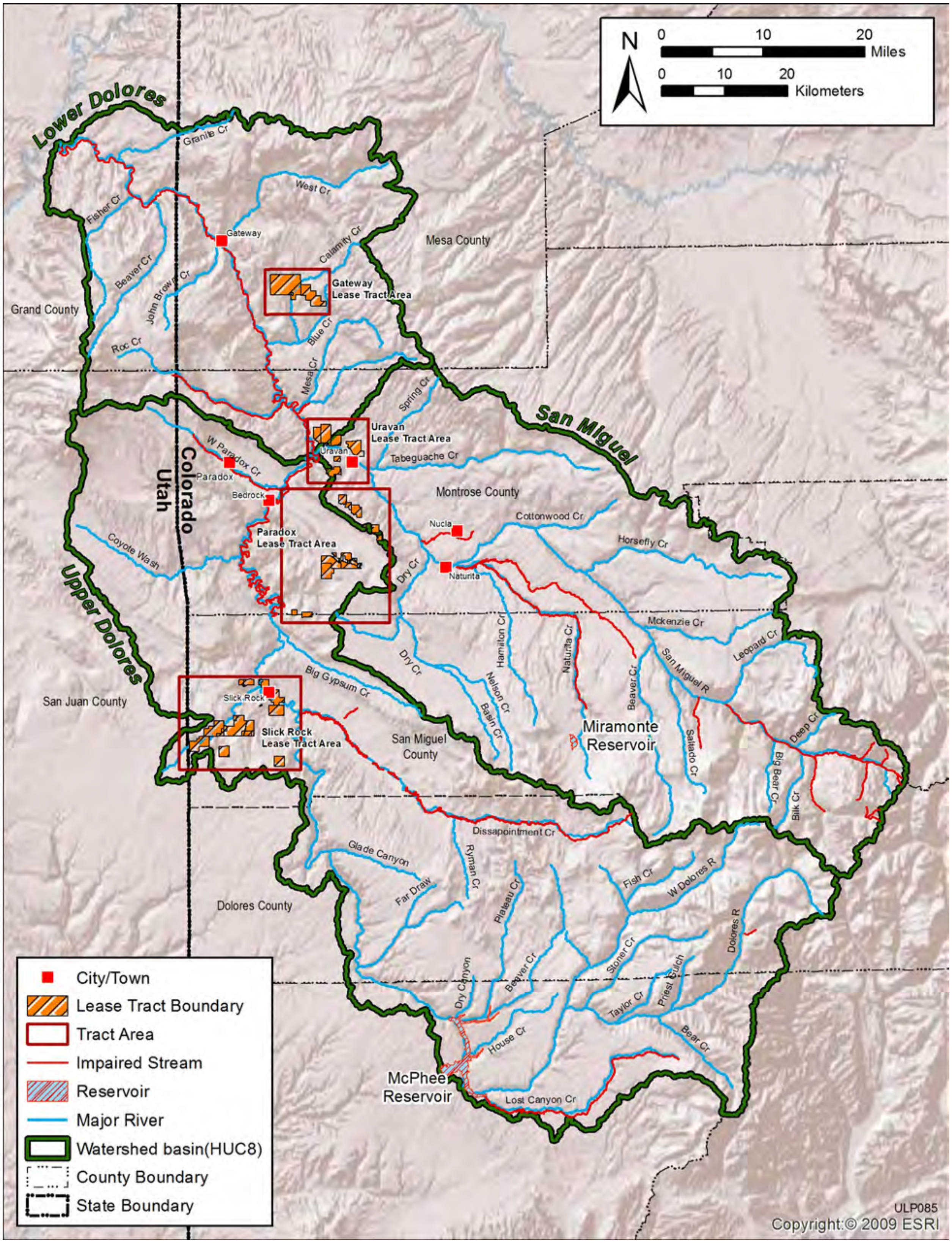

FIGURE 3.4-5 Location of Impaired Water Bodies

further data collection (M&E list). Most of them were added in the 2012 listing cycle. The leading causes of impaired water on the M&E list are elevated concentrations of Pb and other metals in the upper San Miguel River and its tributaries and depleted dissolved oxygen in the lower San Miguel River.

In the Lower Dolores watershed (HUC: 14030004), the lower Dolores River and Roc Creek, a tributary of the Dolores River, located downstream of the Uravan lease tracts, were identified as impaired for their non-attainment of iron and copper standards. A TMDL assessment for these two segments is required with a high priority. The sources of elevated metal in the river segments will be analyzed in the TMDL assessment.

Along the Dolores River near the lease tracts, the total dissolved solids (TDS) content is a primary concern because of the high salinity of the groundwater discharge that occurs as it crosses Paradox Valley, which has a geologic structure that naturally causes the saline groundwater (more details on the geology are provided in Section 3.3). The saline concentration in groundwater in this area has been found in excess of 250,000 mg/L (BOR 2013a). The resulting discharge of saline groundwater to the Dolores River propagates through the river, and it historically increases the TDS loading of the Colorado River by 115,000 to 205,000 tons/yr (Watts 2000; Chafin 2003). The Paradox Valley Unit was built by the BOR in order to capture the high TDS groundwater before it could enter the Dolores River (further information on the Paradox Valley Unit is provided in Section 3.4.3 on water management). By 2001, the Paradox Valley Unit had reduced TDS loads to the Dolores River to 10,600 tons/yr (Chafin 2003). The salinity control program funded by the BOR has been continued along the Dolores River near Bedrock through the Colorado 2012 reporting cycle (CDPHE 2012a,b). Because the existing brine disposal well in the unit is nearing the end of its useful life, a new injection well alternative and an evaporation pond alternative are being considered for future brine disposal (BOR 2013b).

In summary, the existing surface water quality as evaluated by CDPHE (2012a,b) indicates that 10 stream segments and 2 reservoirs are currently impaired in the region of lease tracts that span three watersheds. None of the impaired water is evidently associated with the historical mining activities within the ULP lease tracts. One main segment along the Dolores River near or downstream of the ULP lease tracts is impaired by elevated iron, which is unlikely contributed to the uranium mines in the area. The other impaired waters are located upstream from the lease tracts. In addition, 15 stream segments are suspected to be impaired (M&E list) in the region requiring more data. Most of them are either located upstream of the lease tracts or impaired with nonmetal constituents. Near or downstream of the ULP leased tracts, elevated E. coli is the main concern for the river segment requiring further monitoring and evaluation.

In addition to the state surface water quality database, local monitoring data are also available at the two former uranium mill tailing processing sites located along the Dolores River at Slick Rock, Colorado. These processing sites, Slick Rock East (SRE) and Slick Rock West (SRW), are located in the floodplain of the Dolores River overlying the shallow alluvial aquifer (see Figure 3.4-5). SRE is located entirely within the bounds of ULP Lease Tract 13 (in the northwest corner of the tract), and SRW is located approximately 1 mile downstream of SRE (approximately 2,000 feet west of ULP Lease Tract 13 and 400 feet southwest of Lease Tract 13A). The sites were remediated by removal of tailings and other residual materials as part of the Uranium Milling Tailings Radiation Control Act (UMTRCA) project. The remediation was completed in 1996, and a monitoring program, for both surface water and groundwater, was subsequently established. The groundwater cleanup compliance strategy for the sites is natural flushing, combined with institutional controls and compliance monitoring. COCs at SRE and SRW are mainly manganese, molybdenum, nitrate, selenium, and uranium (DOE 2013). Seven surface water monitoring points are located within the Dolores River upstream from, adjacent to, and downstream from the site, respectively, for both sites. The results from the recent annual sampling event in 2012 indicate that COCs in all samples are currently below the EPA drinking water standard or UMTRCA maximum concentration limit (MCL), except for manganese in SRW downstream sample 0694 (0.055 mg/L), which slightly exceeds the standard (0.05 mg/L). For historical sampling events since 1997, one sample from surface water near the SRE site showed a slightly high concentration of uranium (0.055 mg/L) in 2006. Results are summarized in Table 3.4-3 (DOE 2013).

3.4.2 Groundwater

Groundwater is primarily located in bedrock aquifers and small, isolated alluvial aquifers in the region of the uranium lease tracts. The alluvial aquifers within the study region are primarily composed of gravel, silts, and clays of Quaternary age and located in isolated canyon margins of the Dolores River and the San Miguel River (Topper et al. 2003). Mapped alluvial aquifers near the lease tracts are concentrated along a 19-mi (31-km) reach of the Dolores River west of the Gateway lease tracts, a 20-mi (32-km) reach of West Creek north of the Gateway lease tracts, and a 7-mi (11-km) segment of the San Miguel River east of the Paradox lease tract (CDWR 2011). Near the Slick Rock lease tracts, a limited, shallow alluvial aquifer was also reported along the Dolores River bounded by the canyon wall (DOE 2013). The alluvial aquifers of the Dolores River and the San Miguel River are under unconfined conditions, with depths to groundwater ranging from 2 to 90 ft (0.6 to 27 m) below the surface (Topper et al. 2003). Groundwater yields in the alluvial aquifers of the Dolores River and the San Miguel River range between 1 and 200 gal/min (4.5 and 910 L/min) (CDWR 2011).

The bedrock aquifers within the region of the uranium lease tracts are a part of the regional Paradox Basin, which consists of upper and lower groundwater systems that are separated by confining layers, including salt beds (Topper et al. 2003). Figure 3.4-6 depicts the hydrogeologic stratigraphy of the Paradox Basin, which shows the lower groundwater system as the Paleozoic carbonate aquifer and the upper groundwater system as the Mesozoic sandstone aquifer. The lower groundwater system consists of fractured limestone units overlain by confining salt beds in the Hermosa Group. Groundwater from the lower system is typically saline (Weir et al. 1983). The upper groundwater system consists of layered sedimentary rock beds overlain by a confining shale layer in certain regions and unconsolidated alluvial material in other parts of the basin. Groundwater in the upper sandstone units is typically unconfined where the units crop out along the eastern edge of the Paradox Basin, whereas confined conditions exist farther into the basin (Topper et al. 2003). Groundwater in the sandstone units is typically low in salinity, and these units vary with respect to the amount of fracturing, which controls their groundwater yields (Weir et al. 1983). Reported groundwater yields in the sandstone units are

TABLE 3.4-3 COC Concentrations in the Dolores River at SRE and SRW Sites near Slick Rock Lease Tract 13

Standard or Location	COCs (mg/L) Manganese	Molybdenum	Nitrate as NO_3	Selenium	Uranium
Drinking water standard[a]					
MCL			10	0.05	0.030
SMCL	0.05	0.1[b]			
2012 Monitoring Data[c]					
SRE Site					
0696 (upstream)	–[c]	–	–	–	0.00057
0692 (adjacent)	–	–	–	–	0.0007
0700 (downstream)	–	–	–	–	0.00049
SRW Site					
0693 (upstream)	0.0037	0.0009	<0.044	0.00027	0.00055
0347 (adjacent)	0.0056	0.0009	<0.044	0.00032	0.00057
0349 (adjacent)	0.024	0.0011	<0.044	0.0003	0.00062
0694 (downstream)	**0.055**[d]	0.0016	0.11	0.00032	0.00083
Historical Results (Maximum Concentration since 1996)					
SRE Site					
0696 (upstream)	0.01	0.004	1.55	0.0059	**0.055**[e]
0692 (adjacent)	0.008	0.0041	0.99	0.0043	0.0022
0700 (downstream)	–	–	–	–	0.0014

[a] EPA (2013), http://water.epa.gov/drink/contaminants/index.cfm#List. MCL = maximum contaminant level for primary standard; SMCL = maximum contaminant level for secondary standard.

[b] UMTRCA MCL.

[c] Data obtained from DOE (2013). Monitoring data are rounded to two significant figures. A dash indicates not analyzed.

[d] Bold indicates that the concentration at the sampling point is higher than the standard.

[e] One sample collected in 2006 exceeding the EPA MCL or SMCL.

Era	Period	Million Years before Present	Stratigraphic Unit	Unit Thickness (feet)	Hydrogeologic Unit	Hydrologic Characteristics
Cenozoic	Quaternary	0	Alluvium	0–100	Alluvium	Yields large quantities for domestic, stock, and municipal
		2.6				
Mesozoic	Upper Cretaceous	65.5	Mesaverde Group	100–1,000	Cretaceous confining beds	Confining unit; none
			Mancos Shale	1,000–5,000		
		99.6	Dakota Sandstone	0–200		Yields some water, stock and domestic
	Lower Cretaceous	145.5	Burro Canyon Fm	0–250	Mesozoic sandstone aquifer (Upper Aquifer)	Yields water to springs
	Upper Jurassic		Morrison Formation: Brushy Basin Member	400–500		None
		161	Morrison Formation: Salt Wash Member	300		Yields small quantities, stock and domestic
	Lower and Middle Jurassic		Wanakah Fm (Summerville Fm)	0–120		None
			Entrada Sandstone	15–170		Yields water
			Carmel Formation	0–40		None
			Navajo Sandstone	0–125		Small to moderate amounts from fractures, stock and domestic
		201.6	Kayenta Formation	0–200		Yields little to no water
	Upper Triassic		Wingate Sandstone	0–400		Yields water to numerous springs
			Dolores Formation	150–230	Mesozoic-Upper Paleozoic confining beds	Not water bearing
		235	Chinle Formation	0–500		Yields small quantities where fractured, stock and domestic
	Lower Triassic	251	Moenkopi Formation	0–480		Yields small quantities stock and domestic
Paleozoic	Permian	299	Cutler Formation	0–3,500		Yields small quantities where fractured, stock and domestic
	Pennsylvanian	318	Hermosa Group	0–3,900	Confining salt beds	None
	Mississippian	359	Leadville Limestone	20–100	Lower Paleozoic carbonate aquifer (Lower Aquifer)	Transmits saltwater through fractures
	Devonian to Cambrian	542	Ouray, Elbert, and Ignacio Formations	0–150		

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FIGURE 3.4-6 Conceptual Diagram of the Hydrogeologic Stratigraphy of the Paradox Basin (based on Topper et al. 2003 and Walker and Geissman 2009)

typically less than 20 gal/min (91 L/min), except for isolated regions of high fracturing, which have groundwater yields up to 230 gal/min (1,000 L/min) (CDWR 2011).

Depth to groundwater and groundwater surface elevations are highly dependent on their locations between mesas and valley regions. Depth to groundwater in alluvial aquifers along the rivers ranges from 2 to 90 ft (0.6 to 27 m) below the ground surface, with shallow depths quite commonly found (Topper et al. 2003). Depth to groundwater is greatest beneath mesas; the local groundwater table can be more than 650 ft (200 m) below ground surface in the San Miguel River basin (Ackerman and Rush 1984). However, there are numerous, locally perched aquifers found throughout the Paradox Basin with much shallower groundwater tables (Weir et al. 1983). Table 3.4-4 lists values for the depth to groundwater for USGS monitoring wells within the HUC8 basins of the study region.

Groundwater flow in the alluvium is typically toward the Dolores River and the San Miguel River. Regionally, groundwater from the upper groundwater system flows to the northwest, discharging to the rivers and providing base flow (Weir et al. 1983; Golder Associates 2009). Disruptions of groundwater flow by folds and faults are common in the upper groundwater system, but the effects of similar geologic structures on flow in the lower groundwater system are not known (Weir et al. 1983). Groundwater recharge in the upper groundwater system is primarily from precipitation infiltration, with interbasin inflow considered to be minor (Weir et al. 1983). Groundwater discharge occurs through evapotranspiration and discharge to springs in the study area, but groundwater is primarily discharged to the base flow of the Dolores River and the San Miguel River (Topper et al. 2003). Springs are typically found at high elevations on the flanks of mesas, with more than 200 springs identified in the Dolores River watershed that have an average discharge of 14 gal/min (53 L/min) (Weir et al. 1983). Additional monitoring data for springs in the vicinity of the DOE ULP tracts collected by the USGS are shown in Table 3.4-5.

Groundwater quality in the Paradox Basin is variable; the best quality typically is found in the shallower or more productive units, and the TDS content typically increases with depth (Topper et al. 2003). The sandstone units of the upper groundwater system are typically dominated by calcium- or sodium-bicarbonate, with several units containing TDS and sulfate concentrations that exceed secondary drinking water standards (Weir et al. 1983). The limestone unit of the lower groundwater system is brackish (high salinity) and is not suitable to drink without substantial desalinization treatment (Topper et al. 2003). As described previously, the geologic structure of the Paradox Valley generates a highly saline groundwater discharge to the Dolores River, where the brine has a higher salinity than seawater (Chafin 2003).

Groundwater wells for domestic and municipal water supply were identified for the area within 5 mi (8 km) from the lease tracts based on the Colorado well permit database maintained by the Colorado Division of Water Resources (CDWR). The locations of 88 domestic wells and one municipal well in the area are shown in Figure 3.4-7. The number of wells in the vicinity of each of four lease tracts areas is presented in Table 3.4-6. Among 89 wells, some are owned by mining companies as required water rights for mining activities but are not used for the drinking water supply. Examples of these wells include three “domestic” wells and one “municipal” well located at or near Uravan.

TABLE 3.4-4 Depths to Groundwater Observed in USGS Monitoring Wells Located within the Upper Dolores, San Miguel, and Lower Dolores Basins (HUC8)

USGS Well No.	Elevation[a] (ft)	Well Depth (ft)	No. of Observations	Depth to Groundwater (ft)
Upper Dolores				
382025108530401	5,010	91	10	32.78–39.24
381932108542801	5,130	205	10	107.09–132.03
380258108544400	5,450	125	7	12.88–19.96
375733108370501	6,190	65	1	7.25
375504108353201	6,370	115	1	42.5
372742108300901	6,930	240	11	6–12.99
372930108244800	7,110	132	11	7.25–12.51
375115108242601	7,400	80	4	12.97–41
382043109110201	7,535	160	1	50
373515108094901	8,060	63	4	25–37.27
374242108020501	8,955	49	5	36.68–38.33
San Miguel				
382145108434401	5,020	516	1	58
382229108442101	5,032.75	550	1	117
382131108413901	5,115	200	1	106
381452108321201	5,770	290	1	165
381817108335601	5,802	202	5	90.91–97.83
381212108270301	6,230	92	1	17.2
381029108250801	6,470	50	1	32
381028108243001	6,510	53	10	5.47–22.62
380400108300601	6,880	448	2	106–106.35
380844108163601	7,030	58	8	5.48–19.27
380945108164001	7,102	250	1	74.3
380356108274501	7,125	80	4	5.83–22.3
380646108172001	7,220	96.1	1	60.65
380620108131701	7,450	123	1	41.42
381203108103301	7,830	80	10	34–45.15
380512108083401	8,030	80	1	4.45
375606107482801	8,765	116	1	2.67
375604107483001	8,768	89.8	1	4.22
375534108005801	8,960	180	1	41.75
375602108004401	9,230	180	1	73.1
Lower Dolores				
384026108575701	4,595	140	4	30–95.45
384531108470501	6,230	47	4	17.07–20
390421106533400	7,984	40	1	18

[a] Surface elevations of the wells below 5,500 ft are typically located in canyons and along alluvial areas, and wells located above 5,500 ft are typically located on mesas.

Source: USGS (2011b)

TABLE 3.4-5 Monitoring Data Collected at Springs Located within the Vicinity of the DOE ULP Tracts

USGS Site Number	Elevation (ft)	No. of Observations	Temperature (°C)	Conductivity (μS/cm)	Flow (gal/min)
Upper Dolores (HUC8 Basin)					
375433108244301	9,675	1	15	500	–[a]
375435108244401	9,635	1	10	140	–
375802108362601	6,320	1	11.5	3600	15
381957109051601	6,160	3	11–15	315–332	2–5
382446109022101	7,152	1	8	343	–
San Miguel (HUC8 Basin)					
375710108170901	8,230	1	8.5	290	–
375744108252601	8,385	1	7	498	10
375930108274101	7,315	1	7	2,380	
380205108215401	7,798	2	6.5–7.5	420–590	4
380324108214001	7,490	1	6.5	680	2
380439108185901	7,780	1	17	417	0.32
381427108304201	5,795	1	10	1,400	–
381616108212101	6,235	1	8	775	3
381821108455001	6,615	1	16	700	–
381950108202001	8,425	1	16	220	–
382154108160801	9,485	1	28	180	–
382432108312801	7,400	1	9	490	–
382503108363101	6,470	1	16	600	–
382714108304101	9,265	1	15	600	–
382817108325801	9,385	1	5	440	–
Lower Dolores (HUC8 Basin)					
382756108522001	4,750	1	12	860	20
383326108384801	9,180	1	16	522	–
383521108385301	9,300	1	6	372	–

[a] A dash indicates not available.

The database for the public water supply (PWS) system maintained by the Source Water Assessment and Protection Program at CDPHE indicates that none of PWS wells are located within 5 mi (8 km) of the ULP lease tracts (CDPHE 2012c). In general, the aquifer system in the area has a lower production rate at shallow depths and poorer quality (relatively high TDS, sulfate, etc.) with increasing depths.

On the basis of the registered water well records in the lease tract area, the main water-bearing formations include (a) alluvium along the Dolores River, San Miguel River, and Paradox Valley; (b) Dakota Sandstone and Burro Canyon Formation near the top of Mesa; (c) Saltwash Sandstone in the Morrison Member and Entrada Sandstone near the floor of the valley or river canyon; and (d) underlying Navajo Sandstone and Wingate Sandstone (Figure 3.4-6). All the lease tracts are located upgradient from the main rivers. Within the lease tract areas, the primary

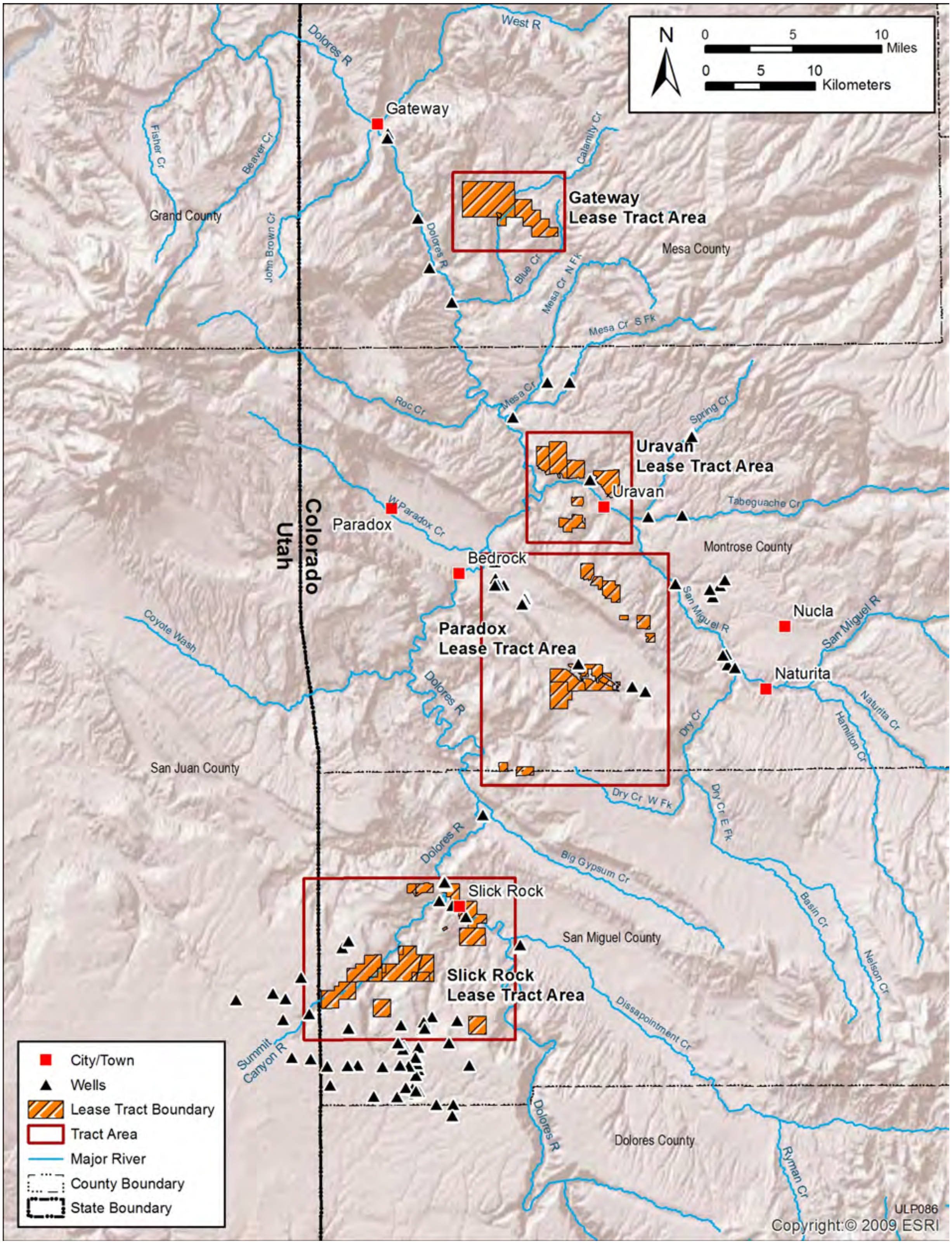

FIGURE 3.4-7 Locations of 88 Domestic Wells and One Municipal Well in and near the Lease Tracts

TABLE 3.4-6 Domestic and Municipal Wells in the Area 5 mi (8 km) from the DOE ULP Lease Tracts

Lease Tract	Number of Wells[a]	Well Depth (ft)	Water Use	Number of Wells within or at the Edge of Lease Tracts[b]	Number of Wells along the Groundwater Flow Pathways[c]
Gateway	5	40–62	Domestic	0	0
Uravan	8	15–204	Domestic	0	1
	1	229	Municipal[d]	0	0
Paradox	22	36–600	Domestic	1	13
Slick Rock	53	24–300	Domestic	5	1

[a] Any wells that are located within 5 mi (8 km) from the lease tracts or along the potential pathways of groundwater flow from the lease tracts to the areas of groundwater discharge. Groundwater quality data from these wells are not available.

[b] Number of wells located within 1,000 ft (300 m) from the lease tracts.

[c] Number of wells located along the potential pathways from lease tracts to the major rivers.

[d] The "Municipal" well (as shown in the database) has been owned by a mining company at Uravan for mining activities and not used for a drinking water supply.

Source: CDWR (http://www.dwr.state.co.us/WellPermitSearch/default.aspx)

source of groundwater recharge is from infiltration of precipitation. The low annual precipitation (12.5 in. [31.8 cm]) and high annual evaporation rate (38 in. [97 cm]; Golder Associates 2009) result in an extremely low quantity of groundwater in the water-bearing formations in the lease tract areas. The highest water well yields are 0.05–1.5 gal/min (0.2–5.7 L/min) (Weir et al. 1983). Some alluvial aquifer along the main rivers outside the lease tract areas may have higher yields above 20 gal/min (76 L/min) (CDWR 2011). The underground mines that penetrate through Alluvium, Dakota, or Burro Canyon water-bearing formations into Saltwash Sandstone were often dry or encountered minimal seepage in the lease tract areas. A "moist" zone identified on the basis of 559 exploration drill holes at Paradox Valley lease tracts area is located in an aquitard, Brushy Basin Member, and inferred as formation water (Cotter Corp. 2012a). Brushy Basin Member (shale interbedded with minor fine-grained sandstone) overlies the ore horizon in the upper Saltwash Sandstone and contains bentonite, preventing water movement (Cotter Corp. 2012a). The uppermost aquifer varies across lease tract areas from Entrada Sandstone, to Navajo Sandstone, Wingate Sandstone (which underlies the confining layers), Summerville Formation, Carmel Formation, and Kayenta Formation, respectively (Figure 3.4-6). In the floodplains of the Dolores River, an alluvial aquifer may directly overlie the Entrada aquifer. A local upward vertical hydraulic gradient from Navajo to Entrada and further to alluvial aquifers may occur in the floodplain as identified in the Slick Rock lease tract area along the Dolores River (DOE 2013).

Information on groundwater quality is limited in lease tract areas. The shallow water-bearing formations (Alluvium, Dakota, and Burro Canyon) are relatively fresh (TDS: 302 to 2,570 mg/L). The water quality of the deep water-bearing formations decreases with increasing depth. The TDS of the Saltwash Member varies from 517 to 13,900 mg/L, and that of the underlying Entrada Sandstone varies from 204 to 14,300 mg/L (Weir et al. 1983). Groundwater from the uranium-containing formation (Saltwash Member) may also have elevated levels of radionuclides and sulfate (DOE 2007; Denison 2008). Although Saltwash Member is unsaturated in most of the ULP lease tracts except for Lease Tract 9 (and possibly 7), groundwater quality in the saturated Saltwash is poor (Cotter Corp. 2012b). The results from one monitoring well completed in the Saltwash Member at Lease Tract 9 over a monitoring period of 2007–2011 indicate that the average concentration is highly elevated for sulfate (2,139 mg/L), selenium (0.68 mg/L), uranium (0.498 mg/L), and radium (5.9 pCi/L for combined radium 226 and 228).

Elevated concentrations of constituents associated with uranium mines have been found in groundwater at the two former uranium mill tailing processing sites, SRE and SRW, located along the Dolores River at Slick Rock, Colorado. These processing sites are located in the floodplain of the Dolores River overlying the shallow alluvial aquifer that resulted in contamination in shallow groundwater. The sites were remediated by removal of tailings and other residual materials as part of the UMTRCA project. The remediation was completed in 1996, and a monitoring program for groundwater was subsequently established. The groundwater cleanup compliance strategy for the sites is natural flushing, combined with institutional controls and compliance monitoring. Groundwater contamination includes selenium and uranium at the SRE site and manganese, molybdenum, nitrate, selenium, and uranium at the SRW site. Most of the contaminants remain on site except for manganese, which exceeds the standard at a downgradient off-site location. The monitoring results are shown in Table 3.4-7.

A few domestic wells (one in Paradox and five in Slick Rock) are within or at the edge of the lease tracts (less than 1,000 ft [310 m] in distance) where groundwater flow might be affected by pumping at these wells. Most of the water wells have shallow to intermediate depths, taking water from alluvial, perched, and/or upper aquifers (sandstone aquifers). Groundwater generally flows directly to the rivers in the alluvial aquifer or flows from the mesa area to springs on the flank of mesas and to the Dolores River and the San Miguel River in upper aquifer. Water wells located along the pathways of groundwater flow from the lease tracts to the areas of groundwater discharge would have relatively high potential to be affected if groundwater within the lease tracts is adversely affected. A total of 15 domestic wells were identified as being located along the potential pathways of groundwater flow, as shown in Table 3.4-6.

3.4.3 Water Management

Water resources and water rights are primarily the responsibility of the CDWR, but several other agencies also address water management issues, including the CDPHE, which oversees stormwater management and water quality issues. Water rights in Colorado are governed by using the Doctrine of Prior Appropriation as the cornerstone; water rights are granted by a water court system and administered by the CDWR (BLM 2001). The DOE ULP lease tracts are located within the boundaries of Divisions 4 and 7 of the CDWR, where both

TABLE 3.4-7 COC Concentrations in Groundwater at SRE and SRW Sites near Slick Rock Lease Tract 13

	COCs (mg/L)				
Standard or Location	Manganese	Molybdenum	Nitrate as NO_3	Selenium	Uranium
Drinking water standard[a]					
MCL			10	0.05	0.030
SMCL	0.05	0.1[b]			
2012 Monitoring Data[c]					
SRE Site					
0300 (upgradient)	–[c]	–	–	–	–
0303 (on site)	–	–	–	–	**0.26**[d]
0305 (on site)	–	–	–	0.014	**0.69**
0307 (on site)	–	–	–	0.0029	**0.59**
0309 (on site)	–	–	–	–	**0.043**
0310 (~600 ft downgradient from site)	–	–	–	–	0.016
SRW Site					
0317 (on site)	–	**0.15**	–	0.0058	–
0318/0318A (on site)	**0.85**	**1.0**	**34**	**2.2**	0.026
0339 (on site)	**1.7**	**1.1**	**44**	**1.8**	**0.030**
0340 (on site)	**5.4**	**1.5**	**320**	**2.4**	**0.045**
0508 (on site)	**2.7**	**1.2**	**200**	**1.1**	**0.080**
0510 (on site)	**3.7**	**0.81**	**210**	**1.1**	**0.083**
0319 (on site)	–	–	–	0.0013	–
0320 (on site)	**0.47**	0.0096	<0.01	0.00033	0.010
0684 (~800 ft downgradient from site)	**0.44**	0.0058	<0.01	0.00012	0.0092

[a] EPA (2013), http://water.epa.gov/drink/contaminants/index.cfm#List. MCL = maximum contaminant level for primary standard; SMCL = maximum contaminant level for secondary standard.

[b] UMTRCA MCL.

[c] Monitoring data are rounded to two significant figures. A dash indicates not analyzed.

[d] Bold indicates that the concentration at the sampling point is higher than the standard.

surface water and groundwater are considered overappropriated (CDWR 2007). In addition, instream flow water rights (nonconsumptive water rights for ecological benefits, which are administered by the Colorado Water Conservation Board [CWCB]) have been established on segments of the Dolores River and the San Miguel River in the vicinity of the DOE ULP lease tracts (CWCB 2012). Surface waters are the dominant water supply source used in southwestern Colorado, and they are primarily used for irrigation (Table 3.4-8).

TABLE 3.4-8 Water Use by Category for Mesa, Montrose, and San Miguel Counties in 2005

	Daily Water Withdrawals (10^6 gal)		
Category of Water Use	Mesa County	Montrose County	San Miguel County
Irrigation	866.3	679.1	27.3
Public supply	14.6	8.9	0.8
Domestic	0.2	0.4	0.1
Industrial	0.6	1.8	0
Livestock	0.6	0.6	0.1
Mining	0.2	0.6	0
Thermo-electric	43.9	1.7	0
Total surface water withdrawals	925.2	691.5	28.0
Total groundwater withdrawals	1.1	1.5	0.3

Source: Ivahnenko and Flynn (2010)

A major water management issue associated with the Dolores River Basin is the Paradox Valley Unit, which was constructed under authorization of the Salinity Control Act (P.L. 93-320) of 1974 to help alleviate the high TDS concentrations that occur in the Dolores River. The Paradox Valley Unit captures highly saline groundwater in the Paradox Valley area before it enters the Dolores River, treats the saline water, and then disposes of the brine by deep well injection (BOR 2013a). The Paradox Valley Unit consists of a series of shallow production wells that intercept saline groundwater and send it to a surface treatment facility, where the brine is removed and re-injected to the lower groundwater system (Paleozoic carbonate aquifer, Figure 3.4-6) that lies 14,000–16,000 ft (4,300–4,800 m) below the land surface (Chafin 2003). The Paradox Valley Unit was built and operated by the BOR, and it removes 110,000 tons of salt per year at a cost of approximately $71/ton (BOR 2013b). The existing deep-injection well, completed in 1988, is nearing the end of its useful life, and action will be needed by BOR to continue long-term salinity control at the Paradox Unit (BOR 2013b). BOR is preparing an EIS to describe the potential alternatives as well as the impacts of the construction and operation of facilities to continue to dispose of brine at Paradox Valley. A new injection well alternative and an evaporation pond alternative, as well as other alternatives, are being considered for future brine disposal (BOR 2013b).

The BOR also built and operates the McPhee Dam located on the Dolores River, which was built in 1984 as a part of the Dolores Project (BOR 2009). The Dolores Project provides water for irrigation (90,900 ac-ft/yr) and municipal and industrial use (8,700 ac-ft/yr). In addition, the McPhee Dam provides water for recreation and hydroelectric power generation (BOR 2011).

3.5 HUMAN HEALTH

3.5.1 Exposure to Radiation

Terrestrial radioactive materials in rocks and soils are one of the causes of the natural background radiation that people are exposed to daily. The radionuclides of concern in the area where DOE uranium lease tracts are located are mainly uranium-238 and uranium-235 and their decay products. Among the decay products of uranium isotopes, radium-226 is of primary concern because of the radon gas generated during decay. The radon gas generated underground can diffuse through the pore space in soils and become airborne. The hazard from radon arises from its decay products, which are not gases; when they are inhaled, they deposit on the interior surfaces of the lungs and affect human health.

3.5.1.1 Radiation and Its Effects

Radiation, either man-made or naturally occurring, is released when an unstable atom of an element (an isotope) transforms (decays) into a more stable configuration. The radiation that is released can be in the form of particles (e.g., neutrons, alpha particles, beta particles) or waves of pure energy (e.g., gamma rays and x-rays).

Radiation can be broadly classified into two categories: ionizing and non-ionizing. Ionizing radiation is generally more energetic than non-ionizing radiation and can knock electrons out of the molecules with which the particles or gamma rays and x-rays interact, creating ion pairs. Non-ionizing radiation, such as that emitted by a laser, is different in that it does not create ions when it interacts with matter but generally dissipates its energy in the form of heat. The radiation associated with uranium ore is ionizing radiation.

> **Radiation**
>
> The health effect of concern from exposure to radiation at levels typical of environmental and occupational exposures is the inducement of cancer. Radiation-induced cancers may take years to develop following exposure and are generally indistinguishable from cancers caused by other sources. Current radiation protection standards and practices are based on the premise that any radiation dose, no matter how small, can result in detrimental health effects (cancer) and that the number of effects produced is in direct proportion to the radiation dose. Therefore, doubling the radiation dose is assumed to result in doubling the number of induced cancers. This approach is called the “linear-no-threshold hypothesis” and is generally considered to result in conservative estimates (i.e., overestimates) of the health effects from low doses of radiation.

Ionizing radiation is a known human carcinogen, and the relationship between radiation dose and health effects is relatively well characterized for high doses of most types of radiation. Some of these cancers can be fatal, and this is referred to as latent cancer fatality (LCF) because the cancer may take many years to develop and cause death. Lower levels of exposure might constitute a health risk, but it is difficult to establish a direct cause-and-effect relationship because a particular effect in a specific individual can be produced by different processes. The features of cancers resulting from radiation are not distinct from those of cancers produced by other causes. Hence, the risk of cancer from chronic exposures of ionizing radiation must be extrapolated from data for increased rates of cancer observed at much higher dose rates. Chronic doses of low-level radiation have not been shown to cause cancer directly, although this assumption has been made in order to be protective.

The amount of energy deposited in ionizing radiation per unit mass of any material is the absorbed dose and is generally expressed in the unit identified as rad (for radiation-absorbed dose). Certain types of radiation are more effective at producing ionizations than others. For the same amount of absorbed dose, alpha particles will produce significantly more biological harm than beta particles or gamma rays. The dose equivalent approach was developed to normalize the unequal biological effects produced by different types of radiation. The dose equivalent is the product of the absorbed dose (in rad) and a quality factor that accounts for the relative biological effectiveness of the radiation. The dose equivalent is typically expressed in a unit identified as rem (for roentgen equivalent man).

The dose delivered to internal organs as a result of radionuclides being systemically incorporated into the body may continue long after intake of the radionuclide has ceased. After being taken into the body, some radionuclides are eliminated fairly quickly, while others are incorporated into tissues or ultimately deposited in bones and can be retained for many years. This internal dose process contrasts with the external dose process, which occurs only when a radiation field is present. The committed dose equivalent was developed to account for doses to internal organs from radionuclides taken into the body. The committed dose equivalent is the integrated dose equivalent to specific organs for 50 years following intake.

The International Commission on Radiological Protection (ICRP) developed the concepts of effective dose equivalent (EDE) and committed effective dose equivalent (CEDE) to account for the differing cancer rates from chronic exposures to radiation by different organs and tissues in the body. The EDE and CEDE are weighted sums of the organ-specific dose equivalents and committed dose equivalents. The weighting factors used in these calculations are based on selected stochastic risk factors and are used to average organ-specific dose equivalents. The total effective dose equivalent (TEDE) is the sum of the EDE for external radiation and the 50-year CEDE for internal radiation. The calculated doses given in the ULP PEIS are the TEDEs, as defined here.

The most common forms of radiation associated with uranium ore are alpha and beta particles and electromagnetic radiation in the form of gamma rays and x-rays. An alpha particle consists of two protons and two neutrons and is identical to the nucleus of a helium atom. Beta particles can be either positive (positron) or negative (negatron); a negatron is identical to an electron. Gamma rays and x-rays have no electrical charge or mass and can travel long distances in air, body tissues, or other materials.

Ionizing radiation can impart sufficient localized energy to living cells to cause cell damage. This damage may be repaired by the cell; the cell may die; or the cell may reproduce other altered cells, sometimes leading to the induction of cancer. An individual may be exposed to radiation from outside the body (external exposure) or, if the radioactive material has entered the body through inhalation or ingestion, from inside the body (internal exposure).

Everyone is exposed to radiation on a daily basis, primarily from naturally occurring cosmic rays, radioactive elements in the soil, and radioactive elements incorporated into the body (such as potassium-40 [K-40]). Man-made sources of radiation include medical x-rays and fallout from previous aboveground nuclear weapons tests and nuclear reactor accidents (such as the accident involving the Chernobyl nuclear reactor in the Soviet Union in 1986). Ionizing radiation causes biological damage only when the energy released during radioactive decay is absorbed by tissue.

Radiation exposures associated with mining uranium ore are expected to be limited to chronic effects. The main health concern associated with chronic exposure to radiation is an increased likelihood of developing cancer, and this impact is assessed in the ULP PEIS. Relatively large doses are required to cause acute effects, and potential mechanisms for such exposures are not expected from activities associated with uranium mining. Acute doses above 25 rad delivered over a short time period can induce a number of deleterious effects, including nausea and vomiting, malaise and fatigue, increased body temperature, blood changes, epilation (hair loss), and temporary sterility; bone marrow changes have not been identified until the acute doses reach 200 rad (Cember 1983). Such exposures are highly unlikely from uranium mining of low-grade ore.

The EPA has developed dose conversion factors (DCFs) for internal and external exposures, and these factors are given in Federal Guidance Report (FGR) 11 (EPA 1988) and FGR 12 (EPA 1993). For internal exposures, the DCF represents the 50-year CEDE per unit intake of radionuclide, and for external exposures, the DCF represents the EDE per unit of time at 1 m (3 ft) above the ground surface per unit of activity concentration of the specified radionuclide. These DCFs given in the two EPA documents are based on the dosimetry models and results given in ICRP 26 (ICRP 1977) and ICRP 30 (ICRP 1979, 1980, 1981). These DCFs were developed on the metabolic and anatomical model of an adult male: the ICRP reference man weighing 70 kg (150 lb).

The ICRP updated its radiation dosimetry models for members of the general public (spanning a range of ages, including adults) in ICRP 72 (ICRP 1996), and the concepts and models included in ICRP 72 are gaining wide acceptance in the scientific community. For the ULP PEIS, the DCFs given in ICRP 72 for adults are used to calculate the doses associated with uranium isotopes and their decay progenies and members of the general public (ICRP 1996). These are the most recent values and provide a reasonable estimate of doses for comparing the various alternatives evaluated in the ULP PEIS.

In addition to estimating the radiation doses (TEDE) for potentially affected individuals, potential collective doses to specific groups of people were also estimated. A collective dose is the sum of the radiation dose each individual in the group received and provides an indication of the potential impact on the group of people as a whole. Other than radiation doses, potential cancer risks associated with radiation exposures were also estimated in this PEIS. For individuals, the estimated cancer risks represent the probabilities of developing a latent fatal cancer due to the radiation each individual received. For a population (i.e., a group of people), the estimated cancer risk represents the amount of latent cancer fatality (LCF) that could occur among the population. The estimated LCF for a population should also be interpreted statistically. For example, if the estimated LCF is 0.006 for a population size of 10,000, this means the average number of deaths for each group of 10,000 people, if the same radiation exposure was applied to many groups of 10,000 people, would be 0.006. In most groups, no one would incur an LCF from the radiation. In a very small percentage of groups (about 0.6%), one LCF would occur. In an extremely small percentage of groups, two or possibly more LCFs would occur. An LCF value of 0.006 for a population can also be viewed as a 0.6% chance of one radiation-induced LCF in that population.

For uranium isotopes and their decay progenies, the LCF risks estimated in the ULP PEIS were obtained by using the EPA slope factors (SFs) from FGR 13 (Eckerman et al. 1999). The SFs are estimated cancer risks per unit intake of radionuclides for internal exposures or per unit time of external exposure associated with a unit radionuclide concentration in a contaminated medium. The SFs for radionuclides were developed by considering the radiation imparted to each critical organ, the age-dependent and organ-specific cancer statistics cause by radiation, and the statistics of life expectancy of the U.S. population. Detailed discussions on the SF methodology can be found in EPA (1994).

An exception to the assessments of radiation doses and cancer risks using DCFs and SFs, respectively, as described above, is the assessment of potential doses and cancer risks associated with radon exposures. Radon is a noble gas generated by the decay of radium that is present in uranium ores and in the natural environment. The risk to human health from radon exposure (through inhalation) is caused by the decay progenies of radon, which are particles and can deposit on the interior surfaces of lung and, potentially, cause a lung cancer. The exposure concentration of radon is usually expressed in terms of working level (WL), which is a measure of the alpha energy released by the short-lived progenies of radon as they decay. Potential exposure to radon is measured in terms of working level month (WLM). One WLM is equivalent to an exposure of 170 hours to a concentration of one WL. UNSCEAR (2008, 2010) recommends that one WLM be equivalent to an effective dose of 506 mrem for workers and 388 mrem for the general public. The different conversions for workers and the general public lie in the different inhalation rates considered for these two groups of receptors. For estimating potential cancer risks, the ICRP (2011) recommends a conversion factor of 5×10^{-4} per WLM.

Another common practice for estimating LCF risks associated with radiation exposures is by converting estimated radiation doses with a dose-to-risk conversion factor. This approach is used in the ULP PEIS for assessing potential LCF risks to different groups of receptors resulting from transportation of uranium ores. The exposures associated with transportation are considered to be mainly from external radiation. The conversion factor relates the radiation dose to the potential number of expected LCFs on the basis of comprehensive studies of groups of people historically exposed to large doses of radiation, such as the Japanese atomic bomb survivors. For the ULP PEIS, a health risk conversion factor of 0.0006 LCF/person-rem was used. This value was identified by the Interagency Steering Committee on Radiation Standards as a reasonable factor to use in the calculation of potential LCFs associated with radiation doses as given in DOE guidance and recommendations (DOE 2003, 2004). This factor means that if a population receives a total collective dose of 10,000 person rem, on average, six additional LCFs will occur among the population.

The LCF estimates provided in the ULP PEIS are in addition to those from other causes. In 2011, the American Cancer Society estimated 572,000 people would die of cancer in the United States, and about three times that number (1,600,000) would be diagnosed with cancer (ACS 2011). Also, the likelihood of developing an LCF from background radiation is about 0.03, based on an average background radiation dose rate of 620 mrem/yr as given by the National Council on Radiation Protection and Measurements (NCRP 2009), a 70-year lifetime, and an LCF factor of 0.0006/rem. The estimate of 620 mrem/yr for background radiation (given in NCRP 2009) includes about 310 mrem/yr from natural sources and 310 mrem/yr from man-made sources, including medical procedures and consumer products. This value is significantly larger than the previous NCRP estimate of 360 mrem/yr primarily because of the increased use of ionizing radiation in diagnostic and interventional medical procedures (NCRP 2009). In the ULP PEIS, estimates of LCFs are given to one significant figure. Table 3.5-1 lists the uranium-mining-related regulations and guidelines for workers and members of the public.

The radionuclides present in the uranium ore occur naturally in the environment and already contribute to background radiation levels. These radionuclides include isotopes of uranium, thorium, and radium and their radioactive decay products. The radiological impacts given in the ULP PEIS are incremental to those from natural and man-made sources of radiation; that is, the impacts are those that an average individual would incur in addition to the 620 mrem/yr noted above. The radiological impacts from uranium ore mining and transportation are analyzed and reported separately without consideration of the background radiation contribution.

A major source of the dose from natural background radiation is indoor radon gas, largely because of its short-lived decay products. Most of this dose is due to radon-222 (and its progeny products), which is a decay product of radium-226, itself a decay product of uranium-238. The doses from the other two naturally occurring isotopes of radon (radon-219 and radon-220) are much lower than the dose from radon-222. The annual radiation dose from the decay products of radon-222 is estimated to be about 200 mrem/yr (NCRP 2009). This dose is from naturally occurring radon gas in soil, rock, and water that infiltrates into houses; in the houses, the gas's decay products (which are charged particles) can build up and attach to dust particles in the air.

3.5.1.2 Baseline Radiological Dose and Risk

The radiation exposure an individual could incur by working or living near the ULP lease tracts could be greater than the national average exposure from background sources, which was estimated to be about 310 mrem per year per person (NCRP 2009). Table 3.5-2 compares these radiation dose estimates with the national average doses.

The information in Table 3.5-2 provides a baseline for gauging human health consequences that could result from the potential increase in human radiation exposures associated with the alternatives evaluated in the ULP PEIS. An additional perspective on background radiation levels in this area can be obtained by studying the environmental monitoring data collected for the proposed Piñon Ridge Mill. The plant would be located in Paradox Valley in western Montrose County, approximately 7 mi (11 km) east of the

TABLE 3.5-1 Uranium-Mining-Related Regulations and Guidelines for Workers and Members of the Public

Regulation/Standard/Guideline	Worker	Member of the Public
40 CFR 61.2,2 Subpart B: National Emission Standards for Radon Emissions from Underground Uranium Mines[a] (Clean Air Act)		Emissions of radon-222 to the ambient air from an underground uranium mine shall not exceed an effective dose equivalent of 10 mrem/yr.
40 CFR 61.92, Subpart H: National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities (Clean Air Act)		Emissions of radionuclides to the ambient air from DOE facilities shall not exceed an effective dose equivalent of 10 mrem/yr.
40 CFR 440.32, Subpart C: Uranium, Radium, and Vanadium Ores Subcategory (Clean Water Act, National Pollution Discharge Elimination System)		Radium-226 (dissolved) mine drainage in pCi/L: 1-day maximum, 10; 30-day average radium-226 (total) mine drainage in pCi/L: 1-day maximum, 30; 30-day average, 10
30 CFR 57.5039: Maximum Permissible Concentration (Federal Mine Safety and Health Act)	Persons shall not be exposed to air containing concentrations of radon progeny exceeding 1.0 WL[b] in active workings.	
30 CFR 57.5038: Annual Exposure Limits (Federal Mine Safety and Health Act)	4 WLM in any calendar year	
30 CFR 57.5046: Protection against Radon Gas (Federal Mine Safety and Health Act)	Where radon progeny concentrations exceed 10 WL, respirator protection against radon gas shall be provided in addition to protection against radon progeny.	
30 CFR 57.5047: Gamma Radiation Surveys (Federal Mine Safety and Health Act)	Individual gamma radiation exposure shall not exceed 5 rem/yr.	
29 CFR 1910.1000, Table Z-1: Limits for Air Contaminants (Occupational Health and Safety Act)	Averaged over an 8-h workday: soluble uranium: 0.05 mg U/m^3 insoluble uranium: 0.25 mg U/m^3	
10 CFR 835.202: Occupational Dose Limits for General Employees (DOE)	Total effective dose of 5 rem (0.05 Sv). The sum of the equivalent dose to the whole body for external exposures and the committed	

TABLE 3.5-1 (Cont.)

Regulation/Standard/Guideline	Worker	Member of the Public
10 CFR 835.202(Cont.)	equivalent dose to any organ or tissue other than the skin or the lens of the eye of 50 rem (0.5 Sv). An equivalent dose to the lens of the eye of 15 rem (0.15 Sv). The sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or to any extremity of 50 rem (0.5 Sv).	
10 CFR 835.208: Limits for Members of the Public Entering a Controlled Area (DOE)		Total effective dose limit for members of the public exposed to radiation and/or radioactive material during access to a controlled area is 0.1 rem (0.001 Sv) per year.
DOE Order 458.1: Radiation Protection of the Public and the Environment, Section 4.b		Total effective dose exceeding 100 mrem (1 mSv) per year, equivalent dose to the lens of the eye exceeding 1,500 mrem (15 mSv) per year, or equivalent dose to the skin or extremities exceeding 5,000 mrem (50 mSv) per year, from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose.
National Institute for Occupational Safety and Health recommendation	Averaged for a workday of up to 10 hours: soluble uranium: 0.05 mg U/m^3 insoluble uranium: 0.2 mg U/m^3 Exposure to soluble uranium should not exceed 0.6 mg U/m^3 for more than 15 minutes.	

[a] Applies if mined, will mine, or is designed to mine over 100,000 tons of ore during the life of the mine; or has had or will have an annual ore production rate greater than 10,000 tons, unless the mine will not exceed total ore production of 100,000 tons during the life of the mine.

[b] Working level (WL) is defined as any combination of the short-lived radon progeny in 1 L of air that will result in ultimate emissions of 1.3×10^5 MeV (million electron volts) of potential alpha energy, and exposure to these radon progeny over a period of time is expressed in terms of working level months (WLMs). Inhalation of air containing a radon daughter concentration of 1 WL for 173 hours results in an exposure of 1 WLM (30 CFR 57.2).

TABLE 3.5-2 Comparison of Radiation Exposures from Natural Background Sources near ULP Lease Tracts Versus the U.S. National Average

Source	Exposure Pathway	Radiation Dose (mrem/yr) U.S. Average Natural Background[a]	Near ULP Lease Tracts
Cosmic and cosmogenic radioactivity[b]	External radiation	30	68[c]
Terrestrial radioactivity[d]	External radiation	20	74[c]
Internal radioactivity[e]	Food ingestion	30	30[f]
Radon and airborne particulates	Inhalation	230	260[g]
Rounded total		310	430

[a] Data for the national averages are from NCRP (2009).

[b] Radiation exposures are from cosmic rays from outer space filtered by the atmosphere.

[c] Based on data for Blanding, Utah.

[d] Radiation exposures are caused by external radiation from radioactive materials in soils, primarily the uranium and thorium decay series.

[e] The internal dose accounts for radiation caused by radionuclides (mainly K-40) deposited inside human bodies through food ingestion.

[f] Radiation exposure from internal radioactivity for the ULP lease tracts is expected to be about the same as the national average.

[g] Based on IUC (2003). The radiation dose is primarily from radon exposure.

unincorporated community of Bedrock and 12 mi (19 km) west of the town of Naturita (Figure 3.5-1). The environmental data collected during 2007–2009 (Edge Environmental, Inc. 2009) include samples of on-site and off-site surface soils, surface water, groundwater, radon, airborne radionuclides, and ambient gamma levels.

To estimate potential radiation exposures from background sources by using the monitoring data, two hypothetical exposure scenarios were developed. The first one considers an individual who lives near the ULP lease tracts and is exposed to radiation for 24 hours a day and 350 days a year. This individual was also assumed to pump out groundwater from a well for drinking. Potential dose estimates reveal that this individual could receive a dose of about 120 mrem/yr from ambient gamma radiation contributed by terrestrial radioactivity and cosmic and cosmogenic radioactivity, a dose of about 290 mrem/yr from inhalation of radon, a dose of about 0.47 mrem/yr from breathing in airborne radionuclides that are contained in resuspended dust particles, and a dose of about 25 mrem/yr from drinking untreated well water. In total, this hypothetical resident could receive a radiation dose of up to 430 mrem/yr, which is about the same as the total listed in Table 3.5-2. Inhalation of radon is the predominant exposure pathway, followed by the external gamma radiation pathway. The contribution to the dose from the inhalation of dust particles is insignificant compared with that from the inhalation of radon. The dose estimate for drinking contaminated groundwater is conservative (i.e., it is greater than the

FIGURE 3.5-1 Location of the Proposed Piñon Ridge Mill (Edge Environmental Inc. 2009)

dose that would actually be incurred by an on-site resident), because (1) no treatment was assumed for the groundwater, (2) the water quality and yield of many wells in the area do not meet the requirements for making them a potable water source, and (3) the estimated dose is associated with the monitoring well that would result in the greatest exposure.

The second hypothetical scenario considers a recreationist who camps, bikes, and hunts in the uranium lease tracts. In addition to camping, biking, and hunting, this recreationist was also assumed to raft, float, and fish in the Dolores River. An exposure duration of 14 days per year was assumed for the inland activities. For the surface water activities, an exposure duration of 100 hours per year was assumed. When the same monitoring data collected by Energy Fuels Resources Corp. were used, it was estimated that the recreationist would receive a total dose of about 10.3 mrem/yr from inland activities, with 6.1 mrem/yr coming from ambient gamma radiation, 2.4 mrem/yr from inhalation of radon, 0.03 mrem/yr from inhalation of radionuclides contained in the airborne dust particles, and 1.8 mrem/yr from ingestion of wildlife animals caught from hunting activities. For dose estimates, an ingestion rate of 100 lb (45 kg) of deer meat was assumed. For the activities in Dolores River, a total dose of 3.3 mrem/yr was estimated, 3.1 mrem/yr resulting from ingestion of fish caught from the river and 0.24 mrem/yr resulting from ingestion of the surface water, which was assumed to be used for cooking the fish. An ingestion rate of 2.6 gal (10 L) for water and 2.2 lb (1 kg) for fish was assumed for dose calculation. A much higher dose for ingestion of fish was calculated than for ingestion of water because of the accumulation potential of radionuclides in fish. While aquatic activities could also occur in the San Miguel River, monitoring data for the San Miguel River are not available for this analysis. Because conservative assumptions were made to estimate the exposures associated with the Dolores River, the estimated results with the Dolores River are considered to be also the upper bound of the potential exposures that could be incurred with the San Miguel River. (For comparison with these dose estimates, the DOE radiation dose limit for the general public resulting from DOE activities is 100 mrem/yr for an individual from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose [DOE 2011b].)

3.5.2 Exposure to Hazardous Chemicals

In addition to resulting in radiation exposures, uranium could also affect human health because of its chemical toxicity. Another chemical of concern is vanadium, which is found to have higher ore concentrations than uranium.

3.5.2.1 Chemical Hazards

Human exposure to chemicals in air, water, and soil may occur through ingestion, inhalation, or contact with skin. Methods used to assess hazards associated with chemical exposures may simply involve a comparison of concentrations in air, water, or soil with health-risk-based standards or guidelines available from state and Federal agencies. More detailed assessments estimate the extent of human exposure due to a particular source and compare that exposure with benchmark levels for noncarcinogenic risks [“hazard index” (HI) approach] or benchmarks for carcinogenic risks. The chemicals of concern in the ULP PEIS are uranium and vanadium, both of which are noncarcinogens.

In estimating noncancer risks (i.e., noncancer adverse health outcomes, such as kidney damage or developmental impairment) due to chemical exposures, the first step is to estimate the chemical concentration in air, water, and/or soil, either present from natural sources or attributable to anthropogenic sources. The concentration estimate is combined with an estimate of the human intake level to produce a chemical-specific daily intake estimate. (The intake level is usually from the upper end of the expected range of possible intakes in order to make sure risk estimates account for individuals who have unusually high intakes.) Estimated intakes are compared with chemical-specific reference doses. The reference doses are developed by the EPA for many commonly used chemicals and are based on a broad range of toxicological data. See the text box for further information on risk estimation procedures.

Key Concepts in Estimating Risks from Low-Level Chemical Exposures

Reference Dose

Oral reference doses and inhalation reference concentrations (RfDs and RfCs, respectively) have been developed by the EPA for estimating the noncarcinogenic effects of substances. The RfD and RfC provide quantitative information for use in risk assessments for an estimate of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Hazard Quotient (HQ)

- A comparison of the estimated intake level or dose of a chemical with its reference dose.
- Expressed as a ratio of estimated intake level to reference dose.
- Examples:
  - The EPA reference level (reference dose) for ingestion of soluble compounds of uranium is 0.003 mg/kg of body weight per day.
  - If a 150-lb (70-kg) person ingested 0.1 mg of soluble uranium per day, the daily rate would be 0.1 ÷ 70 ≈ 0.001 mg/kg, which is below the reference dose and thus unlikely to cause adverse health effects. This would yield a hazard quotient of 0.001 ÷ 0.003 = 0.33.

Hazard Index

- Sum of the hazard quotients for all chemicals to which an individual is exposed.
- Used as a screening tool. A value of less than one indicates that the exposed person is unlikely to develop adverse human health effects. A value of more than one, however, does not necessarily mean adverse health effects will occur, because different chemicals may react differently in the human body (i.e., they may have different, nonadditive kinds of toxicity).

3.5.2.2 Baseline Chemical Risks

Potential chemical risks that could result from potential exposure to uranium and vanadium were assessed by comparing the estimated exposures with threshold values. The threshold values used are reference concentrations (RfCs) for inhalation exposures and reference doses (RfDs) for ingestion exposures. On the basis of the monitoring data obtained by Energy Fuels Resources Corp. (Edge Environmental, Inc. 2009) and by using the same exposure parameters as those used for calculating radiation doses, HIs (sum of HQs for exposures to uranium and vanadium) for the inhalation of particulates and ingestion of water, fish, and wildlife pathways were calculated (Table 3.5-3). The estimates indicate that potential risks from inhaling suspended dust particles containing the uranium and vanadium

TABLE 3.5-3 Estimated Radiation and Chemical Exposures for Receptors in the DOE Lease Tracts Based on Environmental Monitoring Data from Energy Fuels Resources Corp.[a]

Receptor	Radiation Source	Exposure Pathways	Dose to Individual (mrem/yr)	Total Hazard Index
Recreationist[b]	Ambient gamma radiation (including terrestrial radioactivity and cosmic and cosmogenic radioactivity)	External radiation and air submersion	6.05[c]	NA[d]
	Radon	Inhalation	2.41[e]	NA
	Contaminated airborne dust particles	Inhalation	0.031[f]	3.4×10^{-5} [g]
	Contaminated wildlife animals	Ingestion	1.78[h]	0.26[i]
	Contaminated surface water	External radiation and ingestion while rafting/boating/fishing in Dolores River	<0.24[j]	0.002[i]
	Contaminated fish	Ingestion	<3.07[k]	0.03[i]
Resident[l]	Ambient gamma radiation (including terrestrial radioactivity and cosmic and cosmogenic radioactivity)	External radiation and air submersion	121[c]	NA
	Radon	Inhalation	288[e]	NA
	Contaminated airborne dust particles	Inhalation	0.47[f]	8.6×10^{-4} [g]
	Contaminated groundwater	Ingestion	<25[m]	<0.66[i]

Footnotes on next page.

TABLE 3.5-3 (Cont.)

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[a] The environmental monitoring data were obtained from Edge Environmental, Inc. (2009).

[b] The recreationist scenario considers a receptor spending a total of 14 days per year camping, biking, or hunting in the DOE lease tract and 100 hours per year rafting, floating, or fishing in the Dolores River.

[c] The external dose was estimated based on the average monitoring data from five different monitoring stations installed to measure ambient gamma radiation. A conversion factor of 0.9 rem/per roentgen or R was used to convert the measured exposure to radiation dose. A shielding factor of 0.7 was assumed for indoor exposure.

[d] Exposure pathway is not applicable.

[e] The radon inhalation dose was calculated based on the average measured Rn-222 concentration of 1.4 pCi/L. A soil concentration corresponding to the measured radon concentration was derived with the RESRAD computer code (Yu et al. 2001), which was then used to calculate the potential outdoor and indoor radon exposures. For a resident, the resulting outdoor dose was 20.7 mrem/yr, and the resulting indoor dose was 267 mrem per yr. For a recreationist, the resulting dose was 2.4 mrem/yr, considering outdoor exposure. A dose conversion factor of 388 mrem per working level month (WLM) (UNSCEAR 2010) was used to estimate the radon dose.

[f] The radiation dose from inhalation of dust particles was calculated with the monitoring data for airborne radionuclide concentrations and ICRP-60 dose conversion factors (ICRP 1991). An inhalation rate of 8,000 m^3/yr and a dust filtration factor of 0.4 for indoor exposure were assumed. The average radiation dose associated with the concentrations measured for each radionuclide at each monitoring station was calculated first. The individual doses were then added together to obtain the total dose for each monitoring station. The maximum among the five monitoring stations was then reported in this table.

[g] The total inhalation HI was the sum of the HQs for exposures to uranium and vanadium. The vanadium air concentration was assumed to be five times the uranium concentration; this ratio was selected on the basis of the mining production rate of vanadium versus that of uranium. The RfCs used in the calculation were 0.0001 mg/m^3 for V_2O_5 (ATSDR 2012) and 0.0008 mg/m^3 for uranium (ATSDR 2012).

[h] The radiation dose was estimated by assuming the recreationist hunted down a deer and took it home for consumption. The soil concentration derived for radon exposures (see note e above) and an ingestion rate of 100 lb (45.4 kg) were used in the RESRAD calculation. The RESRAD default radionuclide transfer factors for meat were used as surrogates to obtain the radionuclide concentrations in the tissues of deer.

[i] The total ingestion HI was the sum of the HQs for exposures to uranium and vanadium. The reference doses (RfDs) used in the calculation were 0.009 mg/kg-d for V_2O_5 from the Integrated Risk Information System (IRIS) (EPA 2012a) and 0.003 mg/kg-d for uranium, also from IRIS.

Footnotes continued on next page.

TABLE 3.5-3 (Cont.)

[j] The radiation dose was estimated by using the maximum measured concentration of each radionuclide in the Dolores River. The radiation dose estimated includes exposure from external radiation, assuming the receptor sits inside a boat in the middle of the river, and from ingestion of surface water (used for cooking), assuming a total ingestion rate of 10 L/yr.

[k] The radiation dose was estimated by assuming the recreationist caught fish from the Dolores River and cooked the fish with river water. An ingestion rate of 2.2 lb (1 kg) was assumed in the RESRAD dose calculation. Because of the high accumulation potential of radionuclides in fish tissue, the radiation dose calculated for fish ingestion is much higher than that calculated for water ingestion.

[l] The resident scenario assumes a receptor stays in the uranium lease tract for 350 days per year and uses groundwater for drinking.

[m] The radiation dose was obtained with the measured groundwater concentrations from different monitoring wells and ICRP-60 dose conversion factors (ICRP 1991). The radiation dose associated with the average concentrations for each monitoring well was calculated, and the maximum value among the monitoring wells was then reported in this table. A water ingestion rate of 700 L/yr was assumed for the dose calculation.

compounds would be very small. The potential exposures would result primarily from ingestion; with an HI of 0.29 for the recreationist scenario and an HI of 0.66 for the resident scenario. Because the hazard index is less than 1 for all pathways combined for both scenarios, potential adverse effects on human health are not expected from exposures to the uranium and vanadium in the background environment.

3.6 ECOLOGICAL RESOURCES

3.6.1 Vegetation

An ecoregion is an area in which there is a general similarity in ecosystems. Ecoregions are characterized by the spatial patterns and compositions of biotic and abiotic features. EPA has mapped ecoregions of North America features in a hierarchy of four levels, with Level I being the broadest classification and Level IV being the most local classification. Each level consists of subdivisions of the previous (next-highest) level. The ULP lease tracts are located primarily within the Level III Ecoregion 20 (Colorado Plateaus); however, the northeast portion of lease tract 26 occurs within Ecoregion 21 (Southern Rockies) (Chapman et al. 2006).

The Colorado Plateaus ecoregion is characterized by a rugged tableland of mesas, plateaus, mountains, and canyons, often with abrupt changes in local relief (Chapman et al. 2006). Habitat types within this ecoregion include Douglas-fir forest, piñon-juniper woodlands, and Gambel oak, as well as sagebrush steppe, desert shrubland, and salt desert scrub. Within the Colorado Plateaus ecoregion, there are three Level IV ecoregions in which ULP lease tracts are located: Monticello-Cortez Uplands and Sagebrush Valleys; Shale Deserts and Sedimentary Basins; and Semiarid Benchlands and Canyonlands. Figure 3.6-1 shows Level IV ecoregions in the area encompassing the ULP lease tracts. Each of the tracts is located, at least in part, within the Level IV Ecoregion 20c Semiarid Benchlands and Canyonlands. In this ecoregion, sandy soils support sagebrush steppe with warm season grasses, such as galleta grass (*Pleuraphis jamesii*) and blue grama (*Bouteloua gracilis*), and shrubs, primarily black sagebrush (*Artemisia nova*), winterfat (*Krascheninnikovia lanata*), Mormon tea (*Ephedra viridis*), fourwing saltbush (*Atriplex canescens*), and shadscale (*Atriplex confertifolia*). Stony soils support piñon-juniper woodlands of two-needle piñon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*). Scattered woodlands of Gambel oak (*Quercus gambelii*) occur at the higher elevations. Woodlands have expanded beyond their original range because of fire suppression and erosion. The average annual precipitation is about 10 to 18 in. (25 to 46 cm) in lower areas and 20 to 25 in. (51 to 64 cm) at the highest elevations.

Western portions of Lease Tracts 11, 11A, and 12 include the Monticello-Cortez Uplands and Sagebrush Valleys Level IV ecoregion. Within this ecoregion, sagebrush steppe occurs on broad areas of silty soils and is characterized by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), western wheatgrass (*Pascopyrum smithii*), and Indian ricegrass (*Achnatherum hymenoides*) (Chapman et al. 2006). Scattered piñon-juniper woodlands occur on shallow or stony soils along the rims of benches and minor escarpments. Two-needle piñon pine, bitterbrush (*Purshia tridentata*), and serviceberry (*Amelanchier* sp.) also occur in some areas.

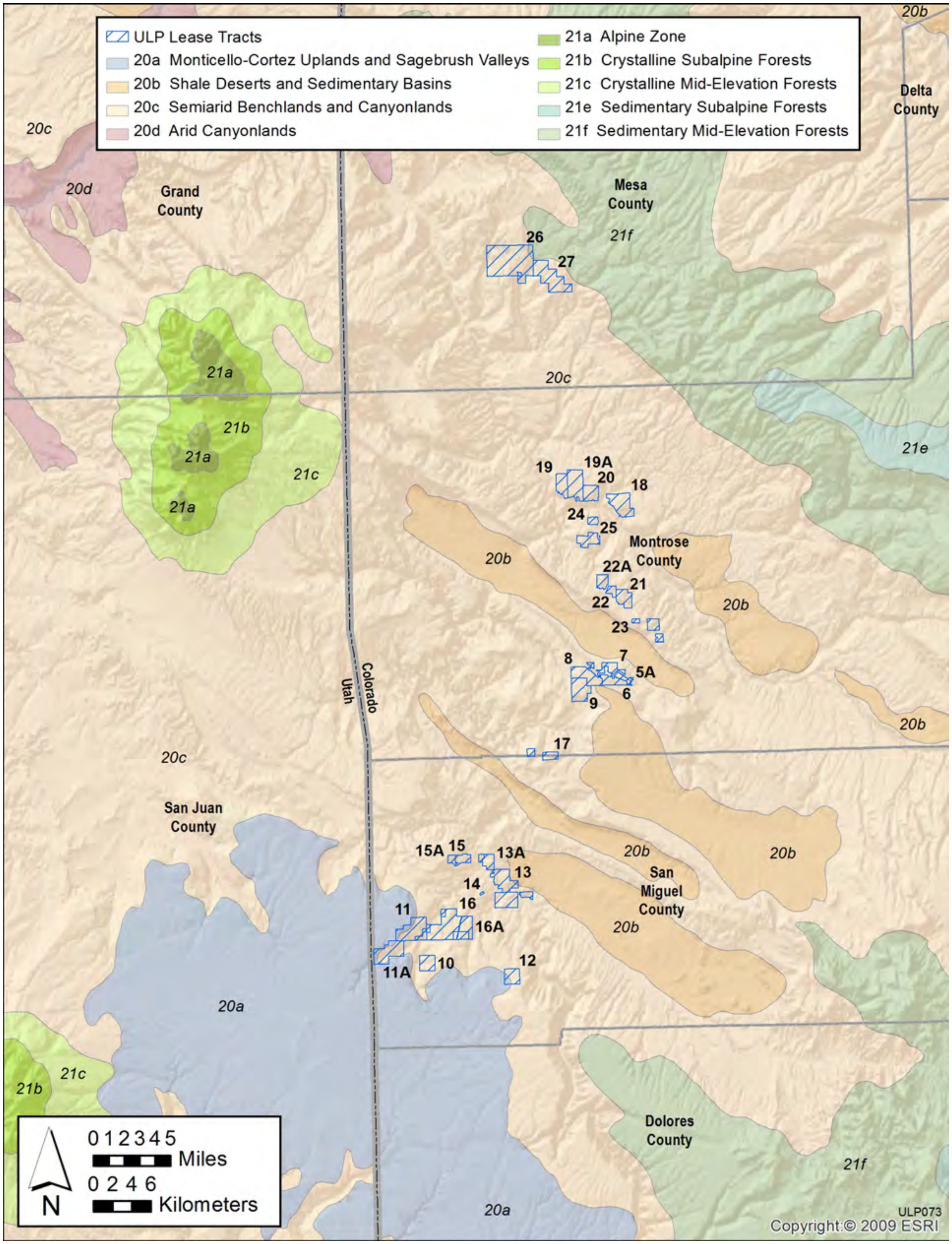


FIGURE 3.6-1 Level IV Ecoregions in the Vicinity of DOE ULP Lease Tracts (Source: Chapman et al. 2006)

A small area in the eastern portion of Lease Tract 13 is located within the Shale Deserts and Sedimentary Basins Level IV ecoregion. This arid ecoregion generally supports sparse mat saltbush shrubland and salt desert scrub (Chapman et al. 2006). Characteristic species include mat saltbush (*Atriplex corrugata*), shadscale, Nuttall's saltbush (*Atriplex nuttallii*), blackbrush (*Coleogyne ramosissima*), fourwing saltbush, Wyoming big sagebrush, bud sagebrush (*Picrothamnus desertorum*), galleta grass, and desert trumpet (*Eriogonum inflatum*). The alkaline soils of floodplains support greasewood (*Sarcobatus vermiculatus*), alkali sacaton (*Sporobolus airoides*), seepweed (*Suaeda* sp.), and shadscale. Badland areas support little to no vegetation.

A small portion in the northeast corner of Lease Tract 26 is located within the Sedimentary Mid-Elevation Forests Level IV ecoregion of the Southern Rockies Level III ecoregion. This ecoregion supports ponderosa pine (*Pinus ponderosa*) forest, aspen (*Populus tremuloides*) forest, and Gambel oak woodland (Chapman et al. 2006). Some areas include mountain mahogany (*Cercocarpus* sp.) and two-needle piñon pine. Shrubs occurring within the habitats of this ecoregion include antelope bitterbrush (*Purshia tridentata*), fringed sage (*Artemisia frigida*), serviceberry, and snowberry (*Symphoricarpos* sp.). Grasses within these habitats include Arizona fescue (*Festuca arizonica*), bluegrass (*Poa* sp.), junegrass (*Koeleria macrantha*), needlegrasses (*Stipa* spp.), mountain muhly (*Muhlenbergia montana*), pine dropseed (*Blepharoneuron tricholepis*), and mountain brome (*Bromus marginatus*).

Land cover types described and mapped under the Southwest Regional Gap Analysis Project (USGS 2004) were used to evaluate plant communities in and near the lease tracts (Figures 3.6-2 through 3.6-5). Each cover type encompasses a range of similar plant communities or other land cover (e.g., quarries, mines, gravel pits, and oil wells). Land cover types occurring within the lease tracts are listed in Table 3.6-1. Summary descriptions of land cover types are given in Table 3.6-2. The predominant land cover type in most of the tracts is Colorado Plateau Piñon-Juniper Woodland. Large areas of Inter-Mountain Basins Big Sagebrush Shrubland occur in Lease Tracts 9, 12, 19A, 20, and 21; Colorado Plateau Piñon-Juniper Shrubland occurs over large areas of Lease Tracts 13, 13A, 14 (T1), and 18; and large areas of Rocky Mountain Gambel Oak-Mixed Montane Shrubland occur in Lease Tracts 10 and 12. While Cultivated Cropland is identified as occurring in many of the lease tracts, it is unlikely that pasture or cultivated lands are present.

Lease Tracts 19A, 20, and 21 consist primarily of a composite of Colorado Plateau Piñon-Juniper Woodland and Inter-Mountain Basins Big Sagebrush Shrubland. Lease Tracts 13A, 14, and 18 are primarily composed of Colorado Plateau Piñon-Juniper Woodland and Colorado Plateau Piñon-Juniper Shrubland. Lease Tract 12 is a mosaic of Inter-Mountain Basins Montane Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland, and Rocky Mountain Gambel Oak-Mixed Montane Shrubland. Lease Tract 13 is a mosaic of Colorado Plateau Piñon-Juniper Woodland, Colorado Plateau Piñon-Juniper Shrubland, Inter-Mountain Basins Greasewood Flat, Inter-Mountain Basins Shale Badland, and Inter-Mountain Basins Mixed Salt Desert Scrub.

Noxious weeds and invasive plant species occur in each of the counties containing uranium lease tracts. The Colorado Department of Agriculture (CDA) maintains an official state list of weed species that are designated noxious species (CDA 2011). Table 3.6-3 provides a

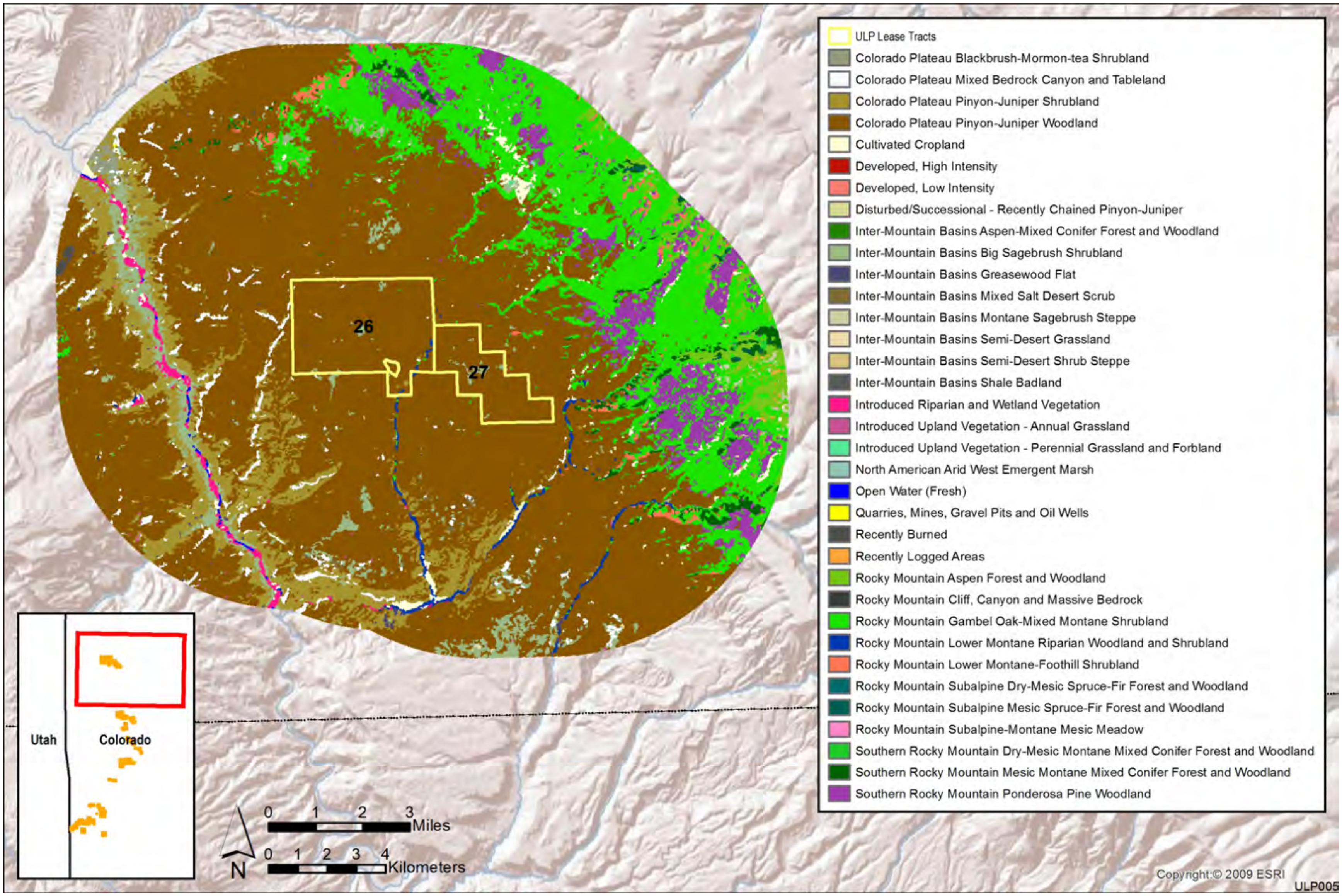


FIGURE 3.6-2 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 26 and 27 (USGS 2004)

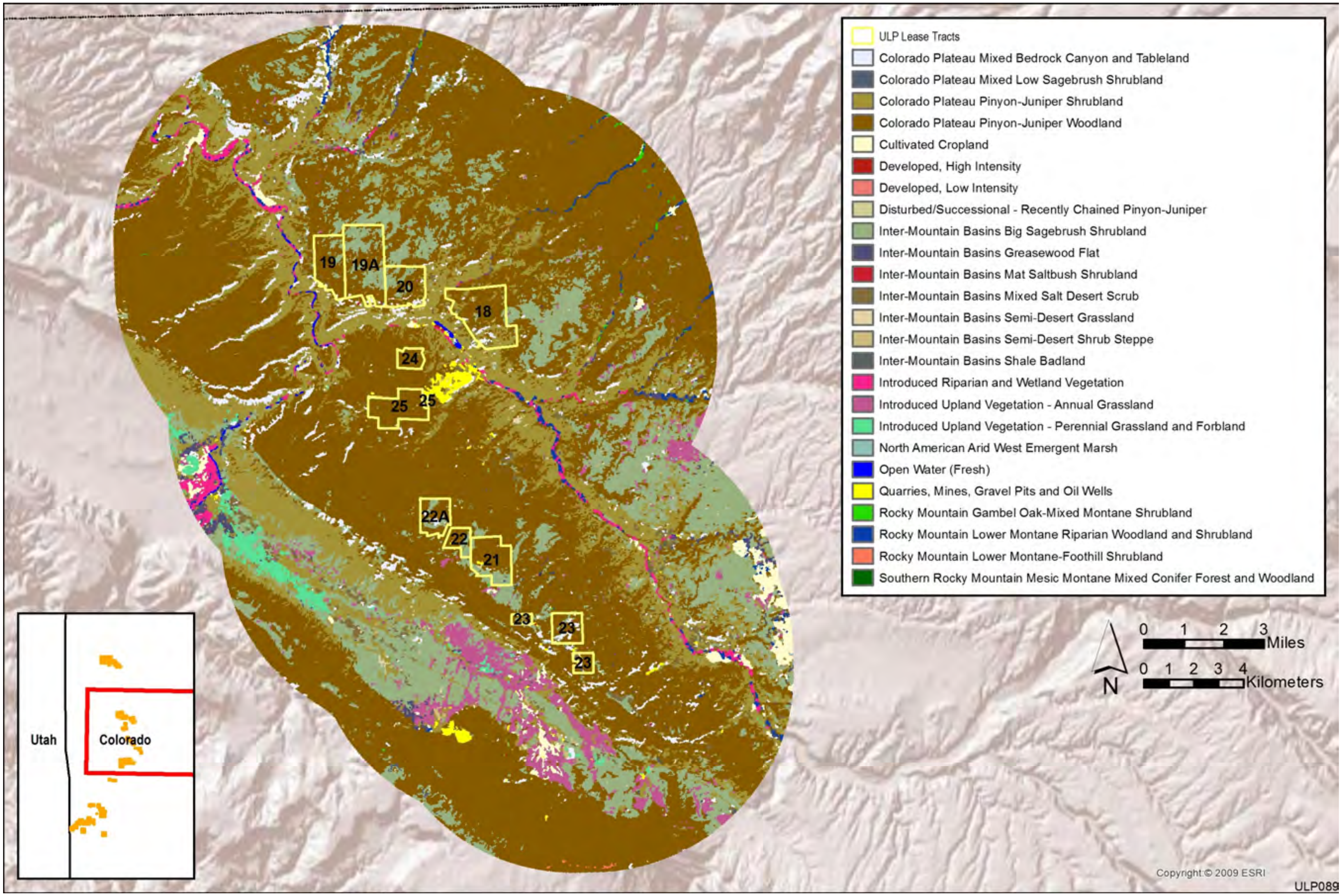


FIGURE 3.6-3 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 18–20, 24, and 25 (USGS 2004)

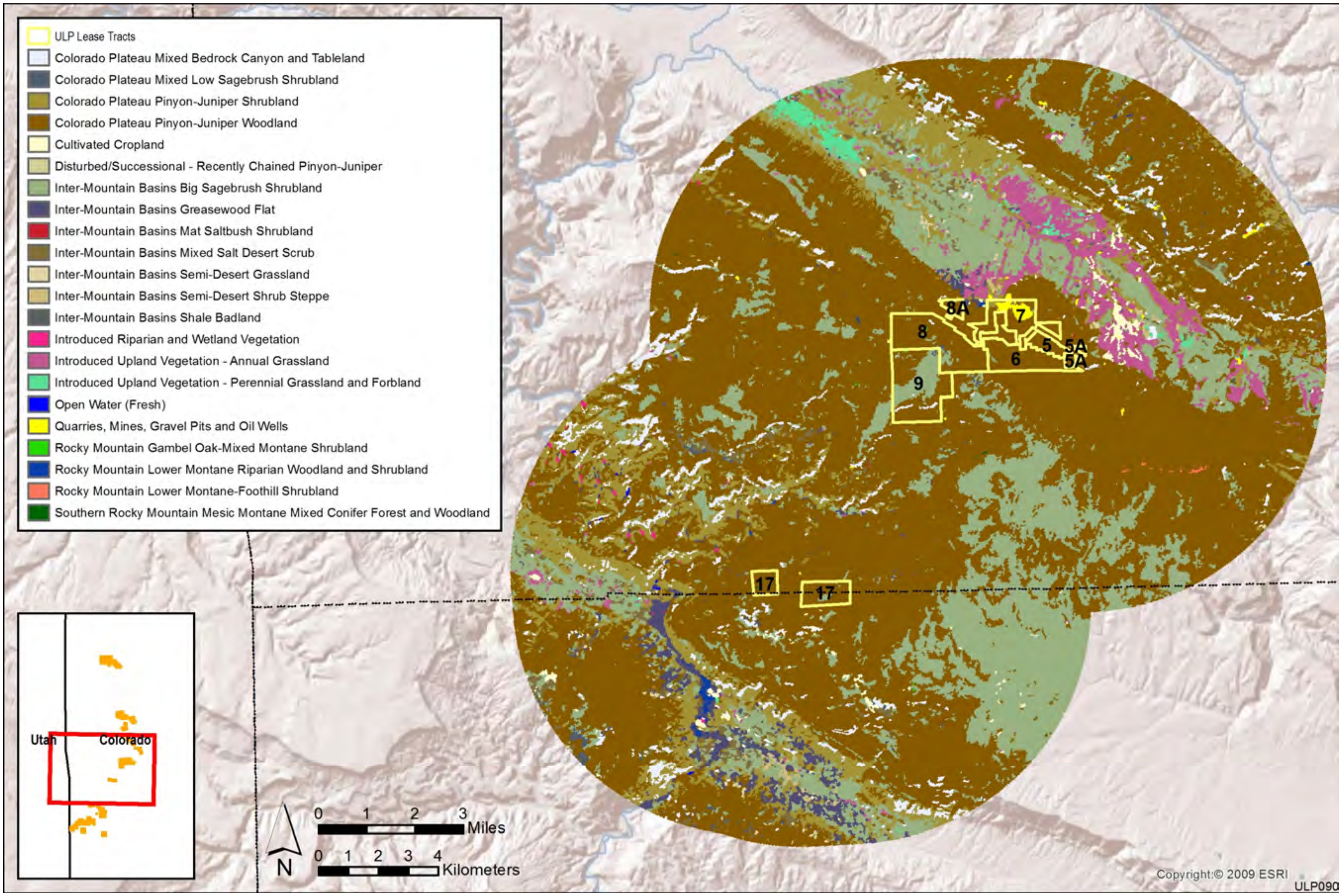


FIGURE 3.6-4 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 5–8, 17, and 21–23 (USGS 2004)

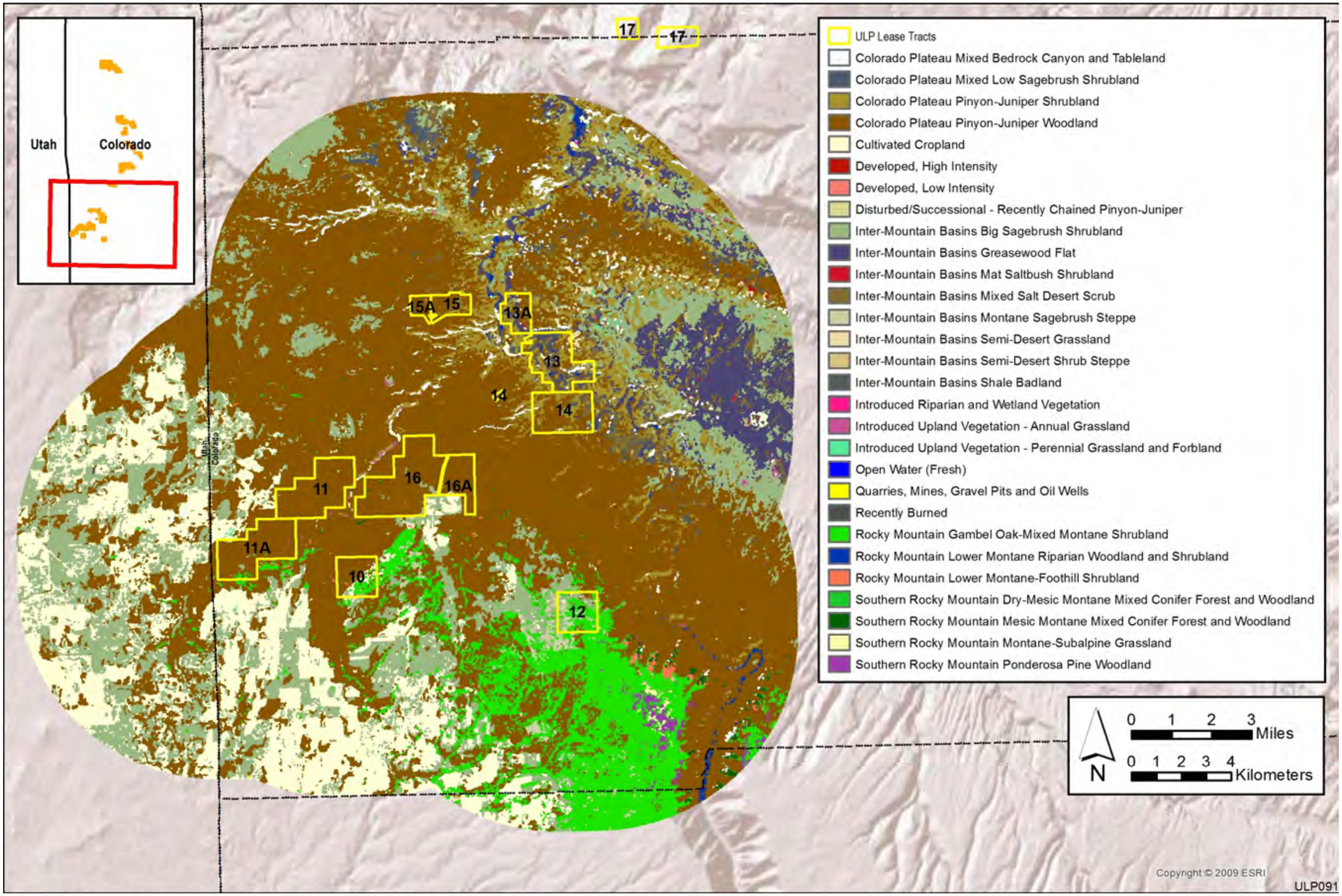


FIGURE 3.6-5 Land Cover Types in the Vicinity of DOE ULP Lease Tracts 10–16 (USGS 2004)

TABLE 3.6-1 Land Cover Types within DOE ULP Lease Tracts

	Acreage by Lease Tract Number							
Land Cover Type[a]	5	5A	6	7	8	8A	9	10
Colorado Plateau Mixed Bedrock Canyon and Tableland			1		4		25	2
Colorado Plateau Mixed Low Sagebrush Shrubland					11		5	
Colorado Plateau Piñon-Juniper Shrubland				21		4	1	
Colorado Plateau Piñon-Juniper Woodland	151	23	522	354	876	75	635	417
Cultivated Cropland					1			71
Disturbed/Successional–Recently Chained Piñon-Juniper					<1			
Inter-Mountain Basins Big Sagebrush Shrubland		2	8	1	62		369	31
Inter-Mountain Basins Greasewood Flat						<1		
Inter-Mountain Basins Mat Saltbush Shrubland								
Inter-Mountain Basins Mixed Salt Desert Scrub				8				
Inter-Mountain Basins Montane Sagebrush Steppe								
Inter-Mountain Basins Semidesert Grassland								
Inter-Mountain Basins Semidesert Shrub Steppe								
Inter-Mountain Basins Shale Badland				2				
Introduced Riparian and Wetland Vegetation								
Introduced Upland Vegetation–Annual Grassland								
Introduced Upland Vegetation–Perennial Grassland and Forbland								
Quarries, Mines, Gravel Pits and Oil Wells				107				
Rocky Mountain Gambel Oak–Mixed Montane Shrubland					2		1	109
Rocky Mountain Lower Montane–Foothill Shrubland								5
Rocky Mountain Lower Montane Riparian Woodland and Shrubland								
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland								<1
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland								2
Southern Rocky Mountain Ponderosa Pine Woodland								

TABLE 3.6-1 (Cont.)

Land Cover Type	Acreage by Lease Tract Number							
	11	11A	12	13	13A	14	15	15A
Colorado Plateau Mixed Bedrock Canyon and Tableland	<1			29	2	8		
Colorado Plateau Mixed Low Sagebrush Shrubland				<1				1
Colorado Plateau Piñon-Juniper Shrubland	4			340	112	238	53	
Colorado Plateau Piñon-Juniper Woodland	1,289	1,242	59	200	154	596	279	168
Cultivated Cropland	2	4	10	6	1			
Disturbed/Successional–Recently Chained Piñon-Juniper								
Inter-Mountain Basins Big Sagebrush Shrubland	4	15	156	21	8	14		1
Inter-Mountain Basins Greasewood Flat	<1			143	67	14		
Inter-Mountain Basins Mat Saltbush Shrubland					3			
Inter-Mountain Basins Mixed Salt Desert Scrub				136	34	77	18	3
Inter-Mountain Basins Montane Sagebrush Steppe			112					
Inter-Mountain Basins Semidesert Grassland				26	12	2		
Inter-Mountain Basins Semidesert Shrub Steppe				2				
Inter-Mountain Basins Shale Badland				163	28	24		
Introduced Riparian and Wetland Vegetation								
Introduced Upland Vegetation–Annual Grassland	2	2						
Introduced Upland Vegetation–Perennial Grassland and Forbland		1						
Quarries, Mines, Gravel Pits and Oil Wells								
Rocky Mountain Gambel Oak–Mixed Montane Shrubland		29	304					
Rocky Mountain Lower Montane–Foothill Shrubland		2						
Rocky Mountain Lower Montane Riparian Woodland and Shrubland				13				
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland								
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland								
Southern Rocky Mountain Ponderosa Pine Woodland			<1					

TABLE 3.6-1 (Cont.)

	Acreage by Lease Tract Number							
Land Cover Type	16	16A	17	18	19	19A	20	21
Colorado Plateau Mixed Bedrock Canyon and Tableland				62	12	14	37	4
Colorado Plateau Mixed Low Sagebrush Shrubland								
Colorado Plateau Piñon-Juniper Shrubland				284	2	16	62	2
Colorado Plateau Piñon-Juniper Woodland	1,726	563	454	761	534	674	361	449
Cultivated Cropland	1	14	2					
Disturbed/Successional–Recently Chained Piñon-Juniper								
Inter-Mountain Basins Big Sagebrush Shrubland	56	7	18	46	91	487	162	178
Inter-Mountain Basins Greasewood Flat					1			2
Inter-Mountain Basins Mat Saltbush Shrubland				<1		1	1	
Inter-Mountain Basins Mixed Salt Desert Scrub				21	24	<1	4	4
Inter-Mountain Basins Montane Sagebrush Steppe								
Inter-Mountain Basins Semidesert Grassland				1				6
Inter-Mountain Basins Semidesert Shrub Steppe				4			1	
Inter-Mountain Basins Shale Badland						2		
Introduced Riparian and Wetland Vegetation				<1				
Introduced Upland Vegetation–Annual Grassland				1			1	
Introduced Upland Vegetation–Perennial Grassland and Forbland								
Quarries, Mines, Gravel Pits and Oil Wells								6
Rocky Mountain Gambel Oak–Mixed Montane Shrubland								
Rocky Mountain Lower Montane–Foothill Shrubland	1							
Rocky Mountain Lower Montane Riparian Woodland and Shrubland								
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland	1							
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	4	1						
Southern Rocky Mountain Ponderosa Pine Woodland								

TABLE 3.6-1 (Cont.)

	Acreage by Lease Tract Number						
Land Cover Type	22	22A	23	24	25	26	27
Colorado Plateau Mixed Bedrock Canyon and Tableland		21	60		5	13	
Colorado Plateau Mixed Low Sagebrush Shrubland							
Colorado Plateau Piñon-Juniper Shrubland			1	5	3	20	
Colorado Plateau Piñon-Juniper Woodland	145	287	442	196	624	3,838	1,696
Cultivated Cropland			5				
Disturbed/Successional–Recently Chained Piñon-Juniper							
Inter-Mountain Basins Big Sagebrush Shrubland	74	94	55		2	51	65
Inter-Mountain Basins Greasewood Flat						1	
Inter-Mountain Basins Mat Saltbush Shrubland							
Inter-Mountain Basins Mixed Salt Desert Scrub		2	20		4		
Inter-Mountain Basins Montane Sagebrush Steppe							
Inter-Mountain Basins Semidesert Grassland		4	2				
Inter-Mountain Basins Semidesert Shrub Steppe					2		
Inter-Mountain Basins Shale Badland			5				
Introduced Riparian and Wetland Vegetation							
Introduced Upland Vegetation–Annual Grassland	1		2				
Introduced Upland Vegetation–Perennial Grassland and Forbland							
Quarries, Mines, Gravel Pits and Oil Wells	3		4				
Rocky Mountain Gambel Oak–Mixed Montane Shrubland						4	
Rocky Mountain Lower Montane–Foothill Shrubland							1
Rocky Mountain Lower Montane Riparian Woodland and Shrubland						22	<1
Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland							
Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland							
Southern Rocky Mountain Ponderosa Pine Woodland							

[a] Descriptions of land cover types are given in Table 3.6-2. Empty fields in the table indicate this land cover type is not found on a given lease tract.

Source: USGS (2004)

TABLE 3.6-2 Descriptions of Land Cover Types[a]

Colorado Plateau Mixed Bedrock Canyon and Tableland: Includes barren and sparsely vegetated (generally <10% plant cover) steep cliff faces, narrow canyons, and open tablelands. Composed of a very open coniferous tree canopy or scattered trees and shrubs. Herbaceous species are typically sparse.

Colorado Plateau Mixed Low Sagebrush Shrubland: Occurs in canyons, draws, hilltops, and dry flats. Consists of open shrubland and steppe habitats. Black sagebrush (*Artemisia nova*) or Bigelow sage (*A. bigelovii*) are the dominant species, with Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*) co-dominant in some areas. Semiarid grasses are often present and may exceed 25% cover.

Colorado Plateau Piñon-Juniper Shrubland: Occurs on rocky mesatops and dry slopes, often upslope of piñon-juniper woodland. Stunted two-needle piñon (*Pinus edulis*) or Utah juniper (*Juniperus osteosperma*), or both, are the dominant species. Other shrubs may be present. Herbaceous species are sparse to moderately dense.

Colorado Plateau Piñon-Juniper Woodland: Occurs on foothills, ridges, and low-elevation mountain slopes. Two-needle piñon (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), or both, are the dominant species. Understory layers, if present, may be shrub- or grass-dominated.

Cultivated Cropland: Areas where pasture/hay or cultivated crops account for more than 20% of total vegetation cover.

Disturbed/Successional–Recently Chained Piñon-Juniper: Areas that have recently been chained to remove Piñon-Juniper (*Pinus edulis-Juniperus* sp.).

Inter-Mountain Basins Big Sagebrush Shrubland: Dominated by basin big sagebrush (*Artemisia tridentata tridentata*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), or both. Other shrubs may be present. Perennial herbaceous plants are present but not abundant.

Inter-Mountain Basins Greasewood Flat: Dominated or co-dominated by greasewood (*Sarcobatus vermiculatus*) and generally occurring in areas with saline soils, a shallow water table, and intermittent flooding, although remaining dry for most growing seasons. This community type generally occurs near drainages or around playas. These areas may include, or may be co-dominated by, other shrubs, and may include a graminoid herbaceous layer.

Inter-Mountain Basins Mat Saltbush Shrubland: Occurs on gentle slopes and rolling plains. Mat saltbush (*Atriplex corrugata*) or Gardner's saltbush (*Atriplex gardneri*) are typically dominant in these dwarf-shrublands. Other dwarf-shrubs may be dominant or co-dominant. Low shrubs may be present and herbaceous species are usually sparse.

Inter-Mountain Basins Mixed Salt Desert Scrub: Generally consists of open shrublands which include at least one species of *Atriplex* along with other shrubs. Perennial grasses dominate a sparse to moderately dense herbaceous layer.

Inter-Mountain Basins Montane Sagebrush Steppe: Occurs on flats, ridges, level ridgetops, and mountain slopes. Mountain big sagebrush (*Artemisia tridentata vaseyana*) and related taxa such as big sagebrush (*Artemisia tridentata spiciformis*) are typically the dominant species. Perennial herbaceous species, especially grasses, are usually abundant, although shrublands are also present.

TABLE 3.6-2 (Cont.)

Inter-Mountain Basins Semidesert Grassland: Consists of perennial bunchgrasses as dominants or co-dominants. Scattered shrubs or dwarf shrubs may also be present.

Inter-Mountain Basins Semidesert Shrub Steppe: Generally consists of perennial grasses with an open shrub and dwarf shrub layer.

Inter-Mountain Basins Shale Badland: Typically occurs on rounded hills and plains. Consists of barren and sparsely vegetated areas (<10% plant cover) with high rate of erosion and deposition. Vegetation consists of sparse dwarf shrubs and herbaceous plants.

Introduced Riparian and Wetland Vegetation: Vegetation dominated (typically >60% canopy cover) by introduced species. These are spontaneous, self-perpetuating, and not (immediately) the result of planting, cultivation, or human maintenance. Land occupied by introduced vegetation is generally permanently altered (converted) unless restoration efforts are undertaken. Specifically, land cover is significantly altered/disturbed by introduced riparian and wetland vegetation.

Introduced Upland Vegetation–Annual Grassland: Dominated by non-native annual grass species.

Introduced Upland Vegetation–Perennial Grassland and Forbland: Dominated by non-native perennial grass and forb species.

Quarries, Mines, Gravel Pits and Oil Wells: Includes open-pit mines and quarries.

Rocky Mountain Gambel Oak–Mixed Montane Shrubland: Occurs on dry foothills and lower mountain slopes. Gambel oak (*Quercus gambelii*) may be the only dominant species or share dominance with other shrubs.

Rocky Mountain Lower Montane–Foothill Shrubland: Occurs on dry foothills, canyon slopes, and lower mountains. These areas are typically dominated by a variety of shrubs. Scattered trees or patches of grassland or steppe may occur.

Rocky Mountain Lower Montane Riparian Woodland and Shrubland: Occurs on stream banks, islands, and bars, in areas of annual or episodic flooding, and often occurs as a mosaic of tree-dominated communities with diverse shrubs.

Southern Rocky Mountain Dry–Mesic Montane Mixed Conifer Forest and Woodland: Occurs on all aspects of mountain slopes, ridges, canyon slopes, and plateaus. Consists of a mix of trees, as well as shrubs and grasses on dry to mesic soils.

Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland: Occurs in cool, moist areas of ravine slopes, stream terraces, and north- or east-facing slopes. A dense layer of diverse deciduous shrubs is often present. A high diversity of herbaceous species, including grasses, sedges, and forbs are present.

Southern Rocky Mountain Ponderosa Pine Woodland: Occurs on dry slopes. Ponderosa pine (*Pinus ponderosa*) is the dominant species. Other tree species may be present. The understory is usually shrubby and grasses may be present.

[a] Land cover descriptions are from USGS (2005)

TABLE 3.6-3 Noxious Weeds Occurring on or in the Vicinity[a] of ULP Lease Tracts

Common Name	Scientific Name	List[b]	Tract[c]
Bull thistle	*Cirsium vulgare*	B	
Canada thistle	*Cirsium arvense*	B	9, 13
Cypress spurge	*Euphorbia cyparissias*	A	
Dalmatian toadflax	*Linaria dalmatica*	B	
Dame's rocket	*Hesperis mattronalis*	B	
Diffuse knapweed	*Centaurea diffusa*	B	
Downy brome/cheatgrass	*Bromus tectorum*	C	5, 7, 10, 11, 12, 13, 16, 18, 19, 21, 22, 23, 25, 26, 27
Dyer's woad	*Isatis tinctoria*	A	
Field bindweed	*Convolvulus arvensis*	C	19, 21, 27
Halogeton	*Halogeton glomeratus*	C	13, 13A, 15, 15A, 17, 18, 19, 19A, 23, 25
Hoary cress	*Cardaria draba*	B	
Houndstongue	*Cynoglossum officinale*	B	
Jointed goatgrass	*Aegilops cylindrica*	B	18
Leafy spurge	*Euphorbia esula*	B	
Musk thistle	*Carduus nutans*	B	7, 8, 9, 11, 19, 23
Oxeye daisy	*Chrysanthemum leucanthemum*	B	
Perennial pepperweed	*Lepidium latifolium*	B	
Purple loosestrife	*Lythrum salicaria*	A	
Redstem filaree	*Erodium cicutarium*	C	10, 11, 16, 18, 19, 21, 22, 25, 26, 27
Russian knapweed	*Acroptilon repens*	B	5, 6, 7, 8, 9, 10, 11, 11A, 13, 13A, 14, 15, 15A, 16, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25
Russian-olive	*Elaeagnus angustifolia*	B	
Salt cedar	*Tamarix ramosissima*	B	9, 13, 13A, 14, 15A, 17, 18, 19, 19A, 20, 22, 22A
Scentless chamomile	*Matricaria perforata*	B	
Scotch thistle	*Onopordium acanthium*	B	
Spotted knapweed	*Centaurea maculosa*	B	
Sulphur cinquefoil	*Potentilla recta*	B	
Yellow toadflax	*Linaria vulgaris*	B	

[a] Mapped within approximately 20 mi (32 km) of lease tracts (CDA 2010).

[b] The CDA classifies noxious weeds into one of three lists (CDA 2011): "List A species in Colorado that are designated by the Commissioner for eradication." "List B weed species are species for which the Commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, develops and implements state noxious weed management plans designed to stop the continued spread of these species." "List C weed species are species for which the Commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, will develop and implement state noxious weed management plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands. The goal of such plans will not be to stop the continued spread of these species but to provide additional education, research, and biological control resources to jurisdictions that choose to require management of List C species."

[c] Tract where species has been recorded within tract boundaries (S.M. Stoller Corporation 2012).

summary of the noxious weed species regulated in Colorado that are known to occur in the vicinity (within approximately 20 mi [32 km]) of the lease tracts (CDA 2010) or have been identified within the boundaries of the lease tracts (S.M. Stoller Corp. 2012).

3.6.1.1 Wetlands and Floodplains

Rocky Mountain Lower Montane Riparian Woodland and Shrubland occurs along segments of Calamity Creek in Lease Tracts 26 and 27 and along the Dolores River in Lease Tract 13 and the withdrawn area of the northwest section of Lease Tract 13A. A small area of Introduced Riparian and Wetland Vegetation occurs in the northwest corner of Lease Tract 18 along Atkinson Creek.

Wetland areas are typically inundated or have saturated soils for at least a portion of the growing season (Cowardin et al. 1979). Wetlands generally support plant communities that are adapted to saturated soil conditions; however, as described in Cowardin et al. (1979), streambeds, mudflats, gravel beaches, and rocky shores are wetland areas that may not be vegetated. Although surface flows provide the water source for some wetlands, such as many riverine marshes, other wetlands, such as springs and seeps, are supported by groundwater discharge. Wetlands are often associated with perennial water sources, such as springs, perennial segments of streams, or lakes and ponds. However, some wetlands, such as vernal pools, have seasonal or intermittent sources of water. Wetlands in the area of the lease tracts have been mapped by the National Wetlands Inventory (NWI) (USFWS 2012). Digital data are not available for this area of Colorado; however, wetlands are mapped and identified by type. Figure 3.6-6 shows an example of NWI mapping in the vicinity of Lease Tracts 13 and 14. Because of the lack of digital data, wetland acreages are not available. Because wetlands may change over time (e.g., boundaries may shift due to new impoundments or wetlands may be eliminated by development), wetlands on the lease tracts may not always correspond to NWI data. Some wetlands occurring in these areas may not be mapped because of the inherent limitations of high-altitude image interpretation. Riverine wetlands occur in many canyon areas within the tracts, including along the Dolores River and named creeks. Small palustrine wetlands occur in several tracts, typically as a result of a dike or impoundment, and may represent livestock watering ponds. Table 3.6-4 lists the NWI mapped wetlands for each tract; Table 3.6-5 gives the description of each wetland type. The lease tracts may include jurisdictional wetlands (those that are under the jurisdiction of Section 404 of the Clean Water Act).

As described in 10 CFR Part 1022, DOE shall determine whether a proposed action would occur within a base or critical floodplain. A base floodplain is the 100-year floodplain (i.e., a floodplain with a 1.0% chance of flooding in any given year). A critical action floodplain is a floodplain (500-year floodplain at a minimum) in which an action could occur for which even a slight chance of flooding would be too great, and it would not apply to the ULP. Portions of Lease Tracts 13, 13A, and 14 are located within the 100-year floodplain of the Dolores River (DOE 2007). Other perennial streams occurring within the lease tracts are Calamity Creek (Lease Tracts 26 and 27) and Atkinson Creek (Lease Tract 18). The floodplains along these streams are unmapped, although the entire area in which Lease Tracts 26 and 27 occur is mapped as a moderate flood hazard area (outside the 100-year flood but not the 500-year flood).

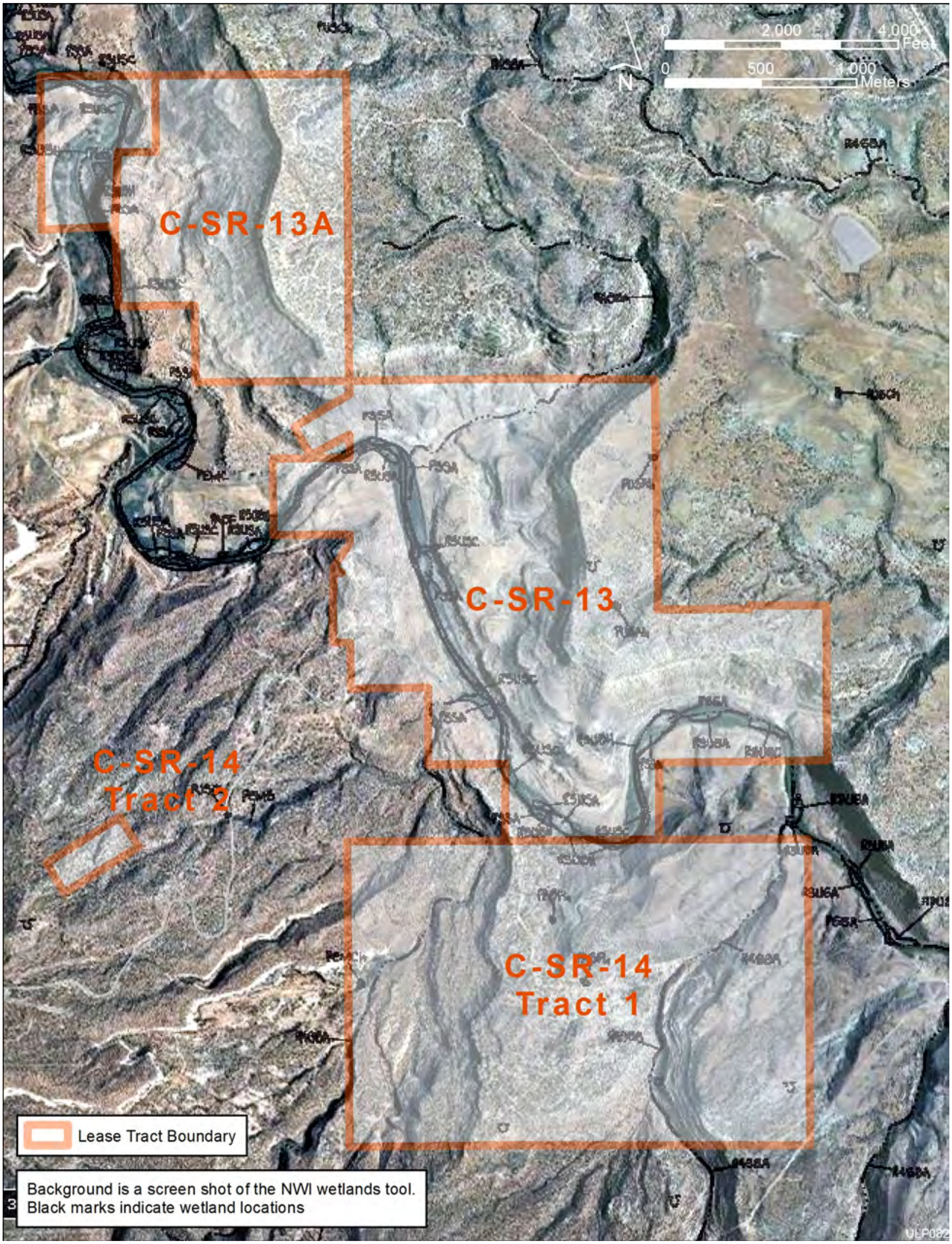


FIGURE 3.6-6 NWI Wetlands Mapped in the Vicinity of Lease Tracts 13 and 14 (USFWS 2012)

TABLE 3.6-4 Wetlands Mapped by the National Wetlands Inventory within ULP Lease Tracts

	Lease Tract Number							
Wetland Type[a]	5	5A	6	7	8	8A	9	10
Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/Impounded								X
Palustrine, Emergent, Seasonally Flooded, Diked/Impounded								
Palustrine, Emergent, Semipermanently Flooded, Diked/Impounded								
Palustrine, Emergent, Temporary Flooded							X	
Palustrine, Emergent, Temporarily Flooded, Diked/Impounded			X					
Palustrine, Scrub-Shrub, Temporary Flooded								
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated				X			X	
Palustrine, Unconsolidated Shore, Semipermanently Flooded, Excavated	X				X			
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded					X			
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated								
Riverine, Intermittent, Streambed, Intermittently Flooded								
Riverine, Intermittent, Streambed, Seasonally Flooded								
Riverine, Intermittent, Streambed, Temporary Flooded							X	X Bishop Canyon
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded								

TABLE 3.6-4 (Cont.)

Wetland Type[a]	Lease Tract Number							
	11	11A	12	13	13A	14	15	15A
Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/Impounded			X			X[2, b]		
Palustrine, Emergent, Seasonally Flooded, Diked/Impounded						X		
Palustrine, Emergent, Semipermanently Flooded, Diked/Impounded								
Palustrine, Emergent, Temporary Flooded								
Palustrine, Emergent, Temporary Flooded, Diked/Impounded								
Palustrine, Scrub-Shrub, Temporary Flooded				X[7] Dolores River	X[4] Dolores River			
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated								
Palustrine, Unconsolidated Shore, Semipermanently Flooded, Diked/Impounded	X							
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded				X[2]				
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated								
Riverine, Intermittent, Streambed, Intermittently Flooded	X Summit Canyon	X Summit Canyon						
Riverine, Intermittent, Streambed, Seasonally Flooded								
Riverine, Intermittent, Streambed, Temporary Flooded	X Summit Canyon	X Summit Canyon		X[2] Burro Canyon Bush Canyon		X[2] Morrison Canyon Bush Canyon	X	
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded				X[3] Dolores River	X[2]	X Dolores River		
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Seasonally Flooded				X[5] Dolores River	X[3] Dolores River			
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded				X[4] Dolores River				

TABLE 3.6-4 (Cont.)

Wetland Type[a]	Lease Tract Number 16	16A	17	18	19	19A	20	21
Palustrine, Aquatic Bed, Semipermanently Flooded Diked/Impounded				X	X	X[2]		
Palustrine, Emergent, Seasonally Flooded Diked/Impounded								
Palustrine, Emergent Semipermanently Flooded, Diked/Impounded	X							
Palustrine, Emergent, Temporary Flooded								
Palustrine, Emergent, Temporary Flooded, Diked/Impounded				X[2]		X		X
Palustrine, Scrub-Shrub, Temporary Flooded								
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated								
Palustrine, Unconsolidated Shore, Seasonally Flooded, Diked/Impounded				X[2]		X		
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded				X			X	
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated								X
Riverine, Intermittent, Streambed, Intermittently Flooded								
Riverine, Intermittent, Streambed, Seasonally Flooded				X Atkinson Creek				
Riverine, Intermittent, Streambed, Temporary Flooded	X	X						X
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Seasonally Flooded								
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded								

TABLE 3.6-4 (Cont.)

Wetland Type[a]	Lease Tract Number 22	22A	23	24	25	26	27
Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/ Impounded	X	X	X	X	X	X[2]	X[2]
Palustrine, Emergent, Seasonally Flooded, Diked/Impounded		X					X
Palustrine, Emergent, Semipermanently Flooded, Diked/Impounded							
Palustrine, Emergent, Temporary Flooded							
Palustrine, Emergent, Temporary Flooded, Diked/Impounded				X			X
Palustrine, Scrub-Shrub, Temporary Flooded							
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated							
Palustrine, Unconsolidated Shore, Seasonally Flooded, Diked/Impounded			X				X
Palustrine, Unconsolidated Shore, Temporary Flooded, Diked/Impounded			X		X	X	
Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated							
Riverine, Intermittent, Streambed, Intermittently Flooded							
Riverine, Intermittent, Streambed, Seasonally Flooded							
Riverine, Intermittent, Streambed, Temporary Flooded						X[2] Maverick Canyon Calamity Creek	
Riverine, Upper Perennial, Unconsolidated Bottom, Semipermanently Flooded						X Calamity Creek	
Riverine, Upper Perennial, Unconsolidated Bottom, Permanently Flooded							
Riverine, Upper Perennial, Unconsolidated Bottom, Seasonally Flooded							
Riverine, Upper Perennial, Unconsolidated Bottom, Temporary Flooded							
Riverine, Upper Perennial Unconsolidated Shore, Seasonally Flooded							
Riverine, Upper Perennial, Unconsolidated Shore, Temporary Flooded							

a See Table 3.6-4 for descriptions of wetland types.

b Superscripts refer to the number of occurrences of that wetland type in the indicated lease tract.

1 **TABLE 3.6-5 Descriptions of Wetland Types**

Aquatic Bed (AB): Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years.

Diked/Impounded (D/I): Created or modified by a human-made barrier or dam that obstructs the inflow or outflow of water. The descriptors “diked” and “impounded” have been combined into a single modifier, since the observed effect on wetlands from either a dike or an impoundment is similar. They have been combined here because of image interpretation limitations.

Emergent (E): Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants.

Excavated (Ex): Lies within a basin or channel that has been dug, gouged, blasted. or suctioned through artificial means by man.

Intermittent (I): Includes channels that contain flowing water only part of the year but may contain isolated pools when the flow stops.

Intermittently Flooded (IF): Limited to describing habitats in the arid western portions of the United States. Substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. These habitats are very climate-dependent. Weeks or months or even years may intervene between periods of inundation. Flooding or inundation may come from spring snowmelt or sporadic summer thunderstorms. The dominant plant communities under this regime may change as soil moisture conditions change. Some areas exhibiting this regime do not fall within the Cowardin et al. (1979) definition of wetland, because they do not have hydric soils or support hydrophytes. This water regime has been used extensively in vegetated and nonvegetated situations, including identifying some shallow depressions (playa lakes), intermittent streams, and dry washes in the arid west.

Palustrine (P): Includes all nontidal wetlands dominated by trees, shrubs, emergents, mosses, or lichens. Wetlands lacking such vegetation are also included if they exhibit all of the following characteristics: (1) are less than 20 acres (8 ha); (2) do not have an active wave-formed or bedrock shoreline feature; (3) have, at low water, a depth of less than 6.6 ft (2 m) in the deepest part of the basin; and (4) have salinity due to ocean-derived salts that is less than 0.5 part per trillion.

Permanently Flooded (PF): Covered by water throughout the year in all years.

Riverine (R): Includes all wetlands and deepwater habitats contained in natural or artificial channels periodically or continuously containing flowing water, or that form a connecting link between the two bodies of standing water. Upland islands or palustrine wetlands may occur in the channel, but they are not part of the riverine system.

Seasonally Flooded (SF): Surface water is present for extended periods, especially early in the growing season, but is absent by the end of the growing season in most years. The water table after flooding ceases is variable, extending from saturated at the surface to a water table well below the ground surface.

Semipermanently Flooded (SPF): Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land’s surface.

Streambed (S): Includes all wetlands contained within the Intermittent Subsystem of the Riverine System.

TABLE 3.6-5 (Cont.)

Scrub-Shrub (SS): Includes areas dominated by woody vegetation less than 6 m (20 ft) tall; the species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions.

Temporary Flooded (TF): Surface water is present for brief periods during growing season, but the water table usually lies well below the soil surface for most of the growing season. Plants that grow both in uplands and wetlands may be characteristic of this water regime.

Unconsolidated Bottom (UB): Includes all wetlands and deepwater habitats with a cover of at least 25% consisting of particles smaller than stones (less than 6–7 cm or 2.4–2.8 in.) and a vegetative cover of less than 30%.

Upper Perennial (UP): This subsystem is characterized by a high gradient and a fast water velocity. Some water flows throughout the year. This substrate consists of rock, cobbles, or gravel, with occasional patches of sand. There is very little floodplain development.

Unconsolidated Shore (US): Includes all wetland habitats having two characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; and (2) less than 30% areal cover of vegetation. Landforms such as beaches, bars, and flats are included in this class.

3.6.2 Wildlife

As discussed in Section 3.6.1, the various ecoregions within the three-county study area within which the lease tracts are located include a diversity of land cover, plant communities, and plant species, which, in turn, provide a wide range of habitats supporting diverse assemblages of terrestrial wildlife species (Table 3.6-6). Many of these species may be expected to inhabit areas within or near the lease tracts, depending upon the plant communities and habitats present.

The BLM and other Federal agencies that administer public lands have active wildlife management programs. These programs are aimed largely at habitat protection and improvement. The general objectives of wildlife management are to (1) maintain, improve, or enhance wildlife species diversity while ensuring healthy ecosystems; (2) restore disturbed or altered habitat with the objective of obtaining desired native plant communities while providing for wildlife needs and soil stability; and (3) protect and maintain wildlife and associated wildlife habitat by addressing and mitigating impacts from authorized and unauthorized uses of BLM-administered lands. Federal agencies such as the BLM are primarily responsible for managing habitats, while state agencies (e.g., Colorado Parks and Wildlife,[15] a division of the Colorado Department of Natural Resources [CDNR]) are responsible for managing the big game, small game, and nongame wildlife species in cooperation with the BLM. The USFWS has responsibility for oversight of migratory bird species and most Federal threatened, endangered,

[15] Colorado Parks and Wildlife was created July 1, 2011, from the merger of Colorado State Parks and the Colorado Division of Wildlife (CDOW). Some of the references listed in Chapter 8 of the ULP PEIS that were prepared by CDOW still mention that within the citation.

TABLE 3.6-6 Number of Wildlife Species in the Three-County Study Area[a]

County	Amphibians	Reptiles	Birds	Mammals
Mesa	10	20	343	83
Montrose	10	20	260	82
San Miguel	9	19	224	81

[a] Excludes native species that have been extirpated and not subsequently reintroduced into the wild, and feral domestic species.

Sources: CPW (2011a); Colorado Field Ornithologists (2010a,b,c)

proposed, or candidate species. Management of threatened and endangered species is discussed in Section 3.6.4.

3.6.2.1 Amphibians and Reptiles

The three-county study area supports a number of amphibian and reptile species (Table 3.6-6). However, amphibian species are not expected to be found throughout most of the lease tracts because of the limited abundance of water bodies and wetlands capable of supporting breeding populations of amphibians. A number of lizard and snake species may inhabit the lease tracts. Turtles do not inhabit areas within the three-county study area (CPW 2011a). Table 3.6-7 lists a number of the amphibian and reptile species expected to inhabit areas within the lease tract boundaries. Threatened, endangered, and other special status amphibian and reptile species (e.g., BLM sensitive species) are addressed in Section 3.6.4.

3.6.2.2 Birds

Several hundred species of birds occur in the three-county study area (Table 3.6-6). The following discussion focuses on major groups of birds that occur within the three-county study area. These include birds that have key habitats within the study area, are important to humans (e.g., waterfowl and upland game species), and/or are representative of other species that share important habitats. Threatened, endangered, and other special status bird species are addressed in Section 3.6.4.

3.6.2.2.1 Waterfowl, Wading Birds, and Shorebirds. Waterfowl (ducks, geese, and swans), wading birds (herons and cranes), and shorebirds (plovers, sandpipers, and similar birds) are among the more abundant groups of birds in the three-county study area. Many of these species migrate extensive distances from breeding areas in Alaska and Canada to wintering

1 **TABLE 3.6-7 Amphibian and Reptile Species Expected To Occur within the Lease Tract**
2 **Boundaries**

Species	Elevation (ft)	Habitat
Amphibians		
New Mexico spadefoot (*Spea multiplicata*)	3,000–6,500	Desert grassland, shortgrass prairie, sagebrush, mixed grassland, piñon-juniper, pine-oak woodlands, and open pine forests. Breeding habitat includes ephemeral artificial impoundments (e.g., stock tanks and pools that form along roads or railroad grades), ephemeral pools and playas, and isolated pools in temporary streams.
Red-spotted toad (*Bufo punctatus*)	3,000–7,000	Usually associated with rocky canyons, occasionally along streams and in canyon bottoms without large rocks.
Tiger salamander (*Ambystoma tigrinum*)	3,000–12,000	Any habitat that has a body of water nearby for breeding (e.g., ponds, lakes, and impoundments ranging from a few meters in diameter to several hectares in area). Virtually any water source may be used for breeding.
Reptiles		
Collared lizard (*Crotaphytus collaris*)	3,000–8,000	Rocky canyons, slopes, and gullies; rocky ledges above cliffs; bedrock exposures; and areas with scattered large rocks and sparse vegetation.
Fence lizard (*Sceloporus undulatus*)	3,000–9,500	Rocky habitats including cliffs, talus, old lava flows and cones, canyons, hogbacks, and outcroppings. Adjacent vegetation includes piñon-juniper woodland, mountain shrubland, semidesert shrubland, and various grasses and forbs. May occur in riparian habitats, but not known to make significant use of aquatic habitat.
Gopher snake (*Pituophis catenifer*)	3,000–8,500	Multitude of habitats including plains grasslands, sandhills, riparian areas, marshes, pond and lake edges, rocky canyons, semidesert and mountain shrublands, piñon-juniper woodlands, ponderosa pine, and rural and suburban areas.
Night snake (*Hypsiglena torquata*)	3,000–8,000	Rocky slopes and canyons sparsely vegetated with piñon-juniper woodland and/or various shrubs and grasses.
Plateau striped whiptail (*Cnemidophorus velox*)	4,500–7,500	Mainly piñon-juniper woodland, but also a wide variety of other grassland, shrubland, and forest habitats.
Sagebrush lizard (*Sceloporus graciosus*)	4,500–8,500	Various habitats including piñon-juniper woodlands, semidesert shrublands, and shale hills with sparse grasses and low shrubs.
Short-horned lizard (*Phrynosoma hernandesi*)	3,000–11,000	Various habitats including short-grass prairie, sagebrush, semidesert shrubland, shale barrens, and piñon-juniper woodland.

TABLE 3.6-7 (Cont.)

Species	Elevation (ft)	Habitat
Reptiles (Cont.)		
Side-blotched lizard (*Uta stansburiana*)	4,500–6,000	Washes, arroyos, boulder-strewn ravines, rocky canyon slopes, bedrock exposures, rimrock outcroppings, rocky cliff bases, and shrubby areas in canyon bottoms where soils are soft and deep. Usually found where there is an abundance of bare ground.
Striped whipsnake (*Masticophis taeniatus*)	4,500–8,500	Semidesert shrublands, piñon-juniper woodlands and shrublands on mesa tops and rocky slopes, and intermittent stream courses and arroyos in the bottoms of canyons.
Tree lizard (*Urosaurus ornatus*)	4,500–8,000	Cliffs, canyon walls, steep bedrock exposures, talus slopes with large boulders, and other areas strewn with huge rocks. Vegetation present includes piñon pine, juniper, and various shrubs.
Western rattlesnake (*Crotalus viridis*)	3,000–9,500	Various habitats including plains grasslands, sandhills, semidesert shrubland, mountain shrubland, riparian zones, and piñon-juniper woodland.
Western whiptail (*Cnemidophorus tigris*)	4,500–6,000	Canyon bottoms to adjacent low mesa tops, preferring open spaced stands of shrubs such as greasewood, sagebrush, or piñon-pine and juniper of friable soils.

Source: CPW (2011a); USGS (2007)

grounds in Mexico and southward (Lincoln et al. 1998). Most are ground-level nesters, and many forage in flocks (sometimes relatively large) on the ground or water. Within the study area, migration routes for these birds are often associated with riparian corridors and wetland or lake stopover areas.

Common to abundant waterfowl and shorebird species reported from the three-county study area include Canada goose (*Branta canadensis*), green-winged teal (*Anas crecca*), mallard (*Anas platyrhynchos*), northern shoveler (*Anas clypeata*), gadwall (*Anas strepera*), ring-necked duck (*Aythya collaris*), great blue heron (*Ardea herodias*), killdeer (*Charadrius vociferous*), spotted sandpiper (*Actitis macularius*), and snow goose (*Chen caerulescens*) (CPW 2011a). Major waterfowl species harvested in the three counties include mallard and Canada goose. Other species commonly harvested include gadwall, American widgeon (*Anas americana*), teal (*Anas* spp.), northern pintail (*Anus acuta*), and northern shoveler (USFWS 2003). In Colorado, no hunting season for the sandhill crane (*Grus canadensis*) occurs west of the Continental Divide (CPW 2011b).

Habitat for most waterfowl, wading birds, and shorebirds in the three-county study area occurs within the larger permanent water bodies, such as the Dolores and San Miguel Rivers.

Waterfowl, wading birds, and shorebirds are limited within the lease tract boundaries because of a lack of their suitable habitats within the lease tracts.

3.6.2.2.2 Songbirds. Songbirds (also referred to as perching birds) of the order Passeriformes represent the most diverse category of birds, with the warblers and sparrows representing the two most diverse groups of passerines. The passerines exhibit a wide range of seasonal movements, with some species remaining as year-round residents in some areas and being migratory in others, and with still other species migrating hundreds of miles or more (Lincoln et al. 1998). Nesting occurs in vegetation from near ground level to the upper canopy of trees. Some songbirds, such as the thrushes and chickadees, are relatively solitary throughout the year, while others, such as swallows and blackbirds, may occur in small to large flocks at various times of the year. Foraging may occur in flight (e.g., swallows and swifts) or on vegetation or the ground (e.g., warblers, finches, and thrushes). Table 3.6-8 lists a number of the songbird species that are expected to inhabit areas within the lease tract boundaries and that are considered by CPW (2011a) to be fairly common to abundant within the three-county study area.

3.6.2.2.3 Birds of Prey. The birds of prey include the raptors (hawks, falcons, eagles, kites, and osprey), owls, and vultures. These species represent the top avian predators in many ecosystems. The raptors and owls vary considerably among species with regard to their seasonal occurrence. Some species are nonmigratory (year-round residents), some species are migratory in the northern portions of their ranges but not in the southern portions of their ranges, and still other species migrate throughout their ranges.

Raptors forage on a variety of prey, including small mammals, reptiles, other birds, fish, invertebrates, and, at times, carrion. They typically perch on trees, utility support structures, highway signs, and other high structures that provide a broad view of the surrounding topography, and they may soar for extended periods at relatively high altitudes. The raptors forage from either a perch or on the wing (depending on the species), and all forage during the day. The owls also perch on elevated structures and forage on a variety of prey, including mammals, birds, and insects. Forest-dwelling species typically forage by diving on a prey item from a perch, while open-country species hunt on the wing while flying low over the ground. While generally nocturnal, some owl species are also active during the day. The vultures, of which only the turkey vulture (*Cathartes aura*) occurs in the three-county study area, are large, soaring scavengers that feed on carrion.

Table 3.6-9 lists a number of the raptor species expected to occur within the lease tract boundaries. Threatened, endangered, and other special status raptor species are discussed in Section 3.6.4.

3.6.2.2.4 Upland Game Birds. Upland game birds that are native to the three-county study area include dusky grouse (*Dendragapus obscurus*), Gambel's quail (*Callipepla gambelii*), mourning dove (*Zenaida macroura*), white-winged dove (*Z. asiatica*), and wild turkey (*Meleagris gallopavo*). Introduced species include ring-necked pheasant (*Phasianus colchicus*)

TABLE 3.6-8 Songbird Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
American crow (*Corvus brachyrhynchos*)	3,000–10,000	Mostly riparian, agricultural, and urban areas, but also coniferous forests, shrublands, and cholla grasslands.
American robin (*Turdus migratorius*)	3,000–11,500	Summer: urban areas around farmhouses and windbreaks; riparian areas; coniferous and aspen forests; and krummholz. During migration: woods and bare or sparsely vegetated fields. Winter: urban, riparian, and agricultural areas; piñon-juniper woodlands; and ponderosa pine forests.
Ash-throated flycatcher (*Myiarchus cinerascens*)	3,000– 9,000	Piñon-juniper woodlands and open riparian forests.
Berwick’s wren (*Thryomanes bewickii*)	3,000–7,000	Dry canyon and piñon-juniper woodlands and semidesert shrublands. Often inhabits tamarisk in summer, and mostly inhabits tamarisk in winter.
Black-billed magpie (*Pica pica*)	3,000–13,000	Most common in riparian forests, agricultural, and urban areas, but also regularly inhabits shrublands, piñon-juniper woodlands, and cholla grasslands.
Black-chinned hummingbird (*Archilochus alexandri*)	3,000–7,000	Piñon-juniper woodlands, lowland and foothill riparian forests, Gambel oak shrublands, and urban areas.
Black-headed grosbeak (*Pheucticus melanocephalus*)	3,000–11,500	Breeds primarily in ponderosa pine, aspen, and foothill riparian forests, piñon-juniper woodlands, and Gambel oak shrublands. Needs to be near water.
Black-throated gray warbler (*Dendroica nigrescens*)	3,000–7,500	Breeds in piñon-juniper woodlands, especially in taller and denser woodlands. Occasionally inhabits other coniferous forest types adjacent to piñon-juniper. During migration it primarily inhabits piñon-juniper woodlands, but occasionally shrublands and lowland riparian forests.
Blue-gray gnatcatcher (*Polioptila caerulea*)	5,000–7,000	Breeds in piñon-juniper woodlands, Gambel oak, mountain mahogany and riparian shrublands. During migration, it inhabits wooded or brushy areas. In winter it inhabits shrublands on dry, sunny slopes or along open streams.
Brewer’s blackbird (*Euphagus cyanocephalus*)	3,000–12,000	Meadows, grasslands, and riparian, agricultural, and urban areas; occasionally sagebrush or other shrublands. During winter, it most often inhabits areas near open water (streams and irrigation canals) and farmyards with livestock.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Brown-headed cowbird (*Molothrus aster*)	3,000–12,000	Breeds mostly in open areas such as grasslands, shrublands, agricultural areas, mountain meadows, and adjacent open forests. During winter, it mostly frequents feedlots or farmyards.
Bushtit (*Psaltriparus minimus*)	5,000–8,500	Primarily piñon-juniper woodlands and in upland and riparian shrublands, also rabbitbrush in fall.
Canyon wren (*Catherpes mexicanus*)	5,000–8,500	Cliffs and on rocky slopes, river canyons, river bluffs, cliffs, and rock slides. Frequents canyons with streams at the bottom.
Chipping sparrow (*Spizella passerine*)	3,000–11,000	Breeds in ponderosa pine forests, riparian and piñon-juniper woodlands, and shrublands. Occasionally inhabits Douglas-fir, lodgepole pine, aspen, or spruce-fir forests, especially adjacent to meadows. During migration, it inhabits weedy fields, agricultural areas, grasslands, and urban areas.
Clark's nutcracker (*Nucifraga columbiana*)	5,500–12,000	Breeds in spruce-fir, Douglas-fir, and limber pine forests; also occurs inhabits aspen forests at all seasons. It wanders to alpine tundra in spring, summer, and fall, and to Gambel oak and mountain mahogany shrublands, riparian, and agricultural areas in fall and early winter. In years of large cone production, large numbers may inhabit ponderosa pine forests and piñon-juniper woodlands.
Cliff swallow (*Petrochelidon pyrrhonota*)	3,000–10,000	Breeds on cliffs and human-made structures such as buildings, bridges, culverts, and dams (mostly in or near open habitats). During migration, it frequents areas around lakes, marshes, and open agricultural areas.
Common nighthawk (*Chordeiles minor*)	3,000–10,000	Inhabits grasslands, sagebrush and semidesert shrublands, open riparian and ponderosa pine forests, piñon-juniper woodlands, agricultural areas, and urban areas. Also forages in other habitats.
Common raven (*Corvus corax*)	5,000–14,000	Breeds on cliffs, and wanders (mostly outside of the breeding season) to adjacent lowlands, mostly in grasslands and shrublands but also in riparian and agricultural areas. Also nests in tall trees and on power poles.
Dark-eyed junco (*Junco hyemalis*)	3,000–10,000	Variety of wooded habitats that have openings with dense herbaceous ground cover. Winters in coniferous and riparian forests and thickets, shrublands, and wooded urban areas.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Dusky flycatcher (*Empidonax oberholseri*)	5,500–11,000	Breeds in fairly open or brushy habitats, such as ponderosa pine forest, hillside shrublands (Gambel oak, mountain mahogany, serviceberry), shrubby openings in piñon-juniper woodlands, montane and foothill riparian forests, small willow thickets, and aspen forests. During migration, it inhabits all wooded or brushy habitats.
Green-tailed towhee (*Pipilo chlorurus*)	3,000–11,500	Breeds most commonly in dry, hillside shrublands (Gambel oak, mountain mahogany, serviceberry, sagebrush), and also in riparian shrublands and piñon-juniper woodlands. Migrates in wooded or brushy riparian and urban areas and shrublands.
Hermit thrush (*Catharus guttatus*)	3,000–11,500	Summer habitat primarily includes spruce-fir forests, but also all other coniferous forest types. In some areas, it is most common in lodgepole pine forests and may be fairly common in dense upper elevation piñon-juniper woodlands. Locally inhabits Gambel oak shrublands, especially those with scattered conifers. During migration, it inhabits wooded habitats.
Horned lark (*Eremophila alpestris*)	3,000–9,000	Breeds in grasslands, sagebrush and semidesert shrublands, and alpine tundra. During migration and in winter, it inhabits the same habitats (except tundra), and also in agricultural areas. It is especially common in stubble and fallow fields and also occurs around feedlots and farmyards in winter. Almost always occurs where plant density is low and there is exposed soil. Can be found in association with prairie dog colonies.
House finch (*Carpodacus mexicanus*)	3,000–10,000	Most common in urban areas and lower piñon-juniper woodlands, but also in agricultural areas, riparian forests, shrublands (sagebrush and rabbitbrush), and cholla grasslands.
Juniper titmouse (*Baeolophus griseus*)	2,250–8,000	Dry habitats of open woodlands. Most common where large mature junipers are present, especially piñon-juniper woodlands. Also forages in shrub and riparian habitats.
Lark sparrow (*Chondestes grammacus*)	3,000–9,000	Inhabits grasslands, shrublands, open riparian areas, and agricultural areas. Sometimes inhabits open piñon-juniper woodlands. Can be found in association with prairie dog colonies.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Lazuli bunting (*Passerina amoena*)	3,000–9,500	Breeds most commonly in Gambel oak shrublands, but also in other hillside shrublands (mountain mahogany, serviceberry, etc.), lowland and foothill riparian forests and shrublands, brushy meadows, sage shrublands, and piñon-juniper woodlands. In all habitats, it requires low shrubs. During migration, it inhabits wooded or brushy areas.
Mountain bluebird (*Sialia currucoides*)	3,000–13,500	In summer, it inhabits mountain grasslands and sage shrublands adjacent to open coniferous forests (especially ponderosa pine and piñon-juniper) and aspen forests. Alpine tundra adjacent to krummholz, and Gambel oak and mountain mahogany shrublands also provide excellent habitat. During migration, it inhabits grasslands, open shrublands, and agricultural areas. In winter, it commonly inhabits piñon-juniper woodlands, but also inhabits shrublands and agricultural areas.
Mountain chickadee (*Poecile gambeli*)	5,500–11,500	Inhabits coniferous and aspen forests. Also occurs in piñon-juniper woodlands. In winter, wandering birds also occur in shrublands, urban areas, and lowland riparian forests.
Northern flicker (*Colaptes auratus*)	3,000–11,500	Grassland, shrubland, forestland, riparian/wetland, and urban/cropland habitats.
Orange-crowned warbler (*Vermivora celata*)	3,000–9,000	During migration, it inhabits riparian and urban areas, but also most other forest and shrubland habitats. In summer, it frequents Gambel oak shrublands, foothill riparian and aspen forests, piñon-juniper woodlands, and montane riparian willow shrublands.
Pine siskin (*Carduelis pinus*)	3,000–11,500	Breeds primarily in coniferous forests (especially spruce-fir) and rarely in riparian areas, aspen forests, and shrublands. Also inhabits ponderosa, lodgepole, and piñon pine. In winter and during migration, it frequents coniferous forests, riparian areas, shrublands, agricultural, and urban areas.
Piñon jay (*Gymnorhinus cyanocephalus*)	5,000–7,000	Inhabits piñon-juniper woodlands. Wandering birds inhabit isolated aspen stands, and alpine tundra.
Plumbeous vireo (*Vireo plumbeus*)	3,000–8,000	Inhabits ponderosa pine forests and piñon-juniper woodlands, especially denser woodlands at the upper elevational range of piñon-juniper and aspen forests, foothill riparian forests, and Gambel oak shrublands with scattered tall trees. Occasionally breeds in lowland riparian forests adjacent to foothills.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Pygmy nuthatch (*Sitta pygmaea*)	5,500–10,000	Inhabits ponderosa pine forests, but may also nest in lodgepole pines and aspens. Wanders rarely to Douglas-fir and piñon-juniper woodlands, and even more rarely to spruce-fir forests and lowland riparian forests.
Rock wren (*Salpinctes obsoletus*)	3,000–12,000	Habitat includes open, rocky slopes and around cliffs. During migration, it inhabits grasslands, brushy slopes, riparian areas, and urban areas.
Ruby-crowned kinglet (*Pegulus calendula*)	3,000–11,500	Breeds in coniferous forests, primarily in spruce-fir, and is common in lodgepole pine forests in some areas. During migration, it frequents all wooded habitats. In winter, it inhabits piñon-juniper woodlands, ponderosa pine forests, planted conifers, urban areas, and lowland riparian forests.
Sage sparrow (*Amphispiza belli*)	3,000–7,000	Breeds in big sagebrush or mixed big sagebrush and greasewood habitats. During migration, it inhabits grasslands and shrublands.
Sage thrasher (*Oreoscoptes montanus*)	3,000–14,000	Breeds in sagebrush shrublands and occasionally in other shrublands or cholla grasslands. During migration and in winter, it inhabits open agricultural areas, pastures, grasslands, shrublands, open riparian areas, and piñon-juniper woodlands.
Say’s phoebe (*Sayornis saya*)	3,000–9,500	Breeds in most open habitats such as grasslands and shrublands, often near buildings (especially if abandoned) and bridges. It generally does not breed in agricultural areas except those adjacent to uncultivated areas. During migration, it inhabits all open habitats, including cultivated and riparian areas. In winter, it is usually found around the open water of streams and sewage ponds. Can be found associated with prairie dog colonies.
Spotted towhee (*Pipilo maculatus*)	3,000–8,000	Prefers scrub oak, shrubby piñon-pine woodlands, and riparian thickets.
Vesper sparrow (*Pooecetes gramineus*)	3,000–13,000	Breeds in grasslands, open shrublands mixed with grasslands, and open piñon-juniper woodlands. During migration, it inhabits open riparian and agricultural areas.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
Virginia's warbler (*Vermivora virginiae*)	3,000–10,000	Breeds in dry, dense hillside shrublands, especially Gambel oak. Habitat includes mountain mahogany and riparian thickets, ponderosa pine forests, and piñon-juniper woodlands, especially with shrubby understories. Occasionally inhabits aspen or Douglas-fir forests, especially those with an understory of shrubs. During migration, it frequents riparian and urban areas and shrublands.
Western bluebird (*Sialia mexicana*)	3,000–8,000	Breeds primarily in ponderosa pine forests (or mixed ponderosa pine/aspen) and less often in piñon-juniper woodlands and Gambel oak shrublands. During migration, it inhabits most open forest types and adjacent open areas. In winter, it frequents piñon-juniper woodlands, but also inhabits riparian areas and shrublands, generally where fruits are abundant.
Western kingbird (*Tyrannus verticalis*)	3,000–10,000	Breeds mostly in open riparian and agricultural areas, but also in piñon-juniper woodlands adjacent to fields and in urban areas. Inhabits grasslands or desert shrublands, mostly in the vicinity of streams, isolated trees, shelterbelts, and houses. Often associated with prairie dog colonies in areas of juniper and cholla or sagebrush.
Western meadowlark (*Sturnella neglecta*)	3,000–12,000	Most common in agricultural areas, especially in winter when it often frequents areas around farmyards. Also inhabits grasslands, croplands, weedy fields, and, less commonly, semidesert and sagebrush shrublands.
Western scrub-jay (*Aphelocoma californica*)	5,000–7,000	Scrub-oak and piñon-juniper woodlands, ponderosa pine forests, wooded creek bottoms, and brushy ravines.
Western tanager (*Piranga ludoviciana*)	3,000–10,500	Breeds most commonly in ponderosa pine and Douglas-fir forests. It also regularly inhabits Gambel oak shrublands, especially those with trees, and piñon-juniper woodlands and aspen forests. During migration, it inhabits lowland riparian forests and wooded urban areas.
Western wood-pewee (*Contopus sordidulus*)	3,000–10,000	Commonly breeds in aspen forests. Also inhabits ponderosa pine and foothill riparian forests. It is generally less common in lodgepole pine, Douglas-fir, lowland riparian forests, and piñon-juniper woodlands. During migration, it frequents wooded riparian and urban areas.
White-breasted nuthatch (*Sitta carolinensis*)	3,000–11,500	Most common in ponderosa pine forests and piñon-juniper woodlands. It also regularly inhabits foothill and lowland riparian forests, and can be found in urban areas, especially in fall and winter.

TABLE 3.6-8 (Cont.)

Species	Elevation (ft)	Habitat
White-throated swift (*Aeronautes saxatalis*)	5,500–10,000	Nests in crevices in cliffs, canyon walls, pinnacles, and large rocks, and in human-made structures that provide crevice-like openings.
Yellow-rumped warbler (*Dendroica coronate*)	3,000–11,000	Nests in forests and open woodlands. During migration and winter, it inhabits open forests, woodlands, savannas, roadsides, pastures, and scrublands.

Sources: CPW (2011a); USGS (2007)

and chukar (*Alectoris chukar*). All the upland game bird species are year-round residents. The Gunnison sage-grouse (*Centrocercus minimus*), no longer considered an upland game bird in Colorado, is addressed in Section 3.6.4.

Table 3.6-10 lists the upland game bird species expected to inhabit areas within the lease tract boundaries.

Figure 3.6-7 shows the activity areas for the wild turkey in the three-county study area (CPW 2011a). Only lease tracts 26 and 27 occur within the overall range and winter range of the wild turkey. Winter habitat includes dense mature conifer stands that provide thermal protection and roost sites (Sargent and Carter 1999). Trees that produce pine nuts, juniper berries, or acorns are also important for food sources in winter (UCDC 2012). Table 3.6-11 provides the acreage of the wild turkey activity areas within the three-county study area and within the combined boundary for the lease tracts.

3.6.2.2.5 Regulatory Framework for Protection of Birds. The Federal regulatory framework for protecting birds includes the ESA, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and E.O. 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds." The ESA is discussed in Section 6.6.4, and the other regulations are discussed briefly here:

- The Migratory Bird Treaty Act implements a variety of treaties and conventions in the United States, Canada, Mexico, Japan, and Russia. This Act provides that it is unlawful to pursue, hunt, take, capture or kill, possess, offer to sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg, or product, manufactured or not, unless permitted by regulations, except as authorized under a valid permit. Most of the bird species reported from the three-county study area Region are classified as migratory under this Act.

TABLE 3.6-9 Raptor Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
American kestrel (*Falco sparverius*)	3,000–10,000	Inhabits virtually all terrestrial habitats, especially during migration. Most often inhabits agricultural areas, grasslands, riparian forest edges, and urban areas.
Cooper's hawk (*Accipiter cooperi*)	3,000–10,000	Mostly breeds in ponderosa pine, Douglas-fir, lodgepole pine, and aspen forests. Some may also inhabit riparian and spruce-fir forests and piñon-juniper woodlands. Migrants and winter residents inhabit the same habitats plus lowland riparian forests and urban areas. Migrants also inhabit open areas such as shrublands, grasslands, and agricultural areas.
Golden eagle (*Aquila chrysaetos*)	3,000–14,000	Inhabits grasslands, shrublands, piñon-juniper woodlands, and ponderosa pine forests. Occasionally inhabits. Nests are located on cliffs and sometimes in trees in rugged areas. Breeding birds range widely over surrounding habitats.
Long-eared owl (*Asio otus*)	3,000–9,000	In lowlands, it primarily inhabits riparian forests and windbreaks, but also urban areas and tamarisk thickets. In mountains, it primarily inhabits dense Douglas-fir forests. It primarily inhabits areas where there are dense, tall shrubs and/or trees. Also recorded from foothill shrublands, piñon-juniper woodlands, aspen forests, and spruce-fir forests.
Northern harrier (*Circus cyaneus*)	3,000–9,500	Inhabits grasslands, shrublands, agricultural areas, and marshes; also observed on alpine tundra in the fall. Breeds mainly in wet habitats.
Northern pygmy-owl (*Glaucidium gnoma*)	5,000–10,000	Inhabits coniferous forests, piñon-juniper woodlands, aspen forests, and foothills and montane riparian forests. Prefers canyons with running water and ecotonal areas.
Northern saw-whet owl (*Aegolius acadicus*)	5,500–10,000	Prefers dense forests or woodlands associated with water. Mostly inhabits ponderosa pine, Douglas-fir forests, lodgepole pine, spruce-fir and montane riparian forests, and piñon-juniper woodlands.
Prairie falcon (*Falco mexicanus*)	3,000–14,000	Breeding birds nest on cliffs or bluffs in open areas, and range widely over surrounding grasslands, shrublands, and alpine tundra. Migrants and winter residents mostly inhabits grasslands, shrublands, and agricultural areas.
Red-tailed hawk (*Buteo jamaicensis*)	3,000–13,500	Inhabits open areas with scattered, elevated perch sites in a wide range of altitudes and habitats such as scrub desert, plains and montane grasslands, agricultural fields, pastures, urban parklands, and broken coniferous and deciduous woodlands.

TABLE 3.6-9 (Cont.)

Species	Elevation (ft)	Habitat
Sharp-shinned hawk (*Accipiter striatus*)	3,000–11,500	Breeds in ponderosa pine, Douglas-fir, aspen, lodgepole pine, and spruce-fir forests; some may also inhabit riparian forests or piñon-juniper woodlands. Migrants and winter residents inhabit most types of forests and in urban areas and are often observed over open areas, such as shrublands, grasslands, and agricultural areas.
Swainson's hawk (*Buteo swainsoni*)	3,000–10,000	Inhabits grasslands, agricultural areas, shrublands, and riparian forests. Nests in trees in or near open areas. Migrants are often observed in treeless areas.
Turkey vulture (*Cathartes aura*)	3,000–9,000	Migrants and foraging birds inhabit most open habitats such as grasslands, shrublands, and agricultural areas. Nests on cliffs. Nests are located on the ground under vegetation; fallen, hollow logs; broken tree stumps; or in caves.
Western screech-owl (*Otus kennicottii*)	3,000–9,000	Inhabits mature lowland and foothill riparian forests with shrubby undergrowth and rural woodlots; also inhabits aspen and coniferous forests and from piñon-juniper woodlands.

Sources: CPW (2011a); USGS (2007)

TABLE 3.6-10 Upland Game Bird Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
Chukar (*Alectoris chukar*)	4,500–6,000	Inhabits desert areas with rocky canyons, steep hillsides, scattered bushes, and blankets of cheatgrass.
Gambel's quail (*Callipepla gambelii*)	4,500–7,000	Inhabits semidesert sagebrush and rabbitbrush shrublands, and adjacent agricultural areas. Requires tall shrubs such as greasewood and tamarisk.
Mourning dove (*Zenaida macroura*)	3,000–11,500	Inhabits grasslands, shrublands, croplands, lowland and foothill riparian forests, ponderosa pine forests, and urban areas. Rarely inhabits aspen forests, coniferous woodlands, forests other than ponderosa pine, and alpine tundra. In winter it mostly inhabits lowland riparian forests adjacent to cropland.
Wild turkey (*Meleagris gallopavo*)	3,000–8,000	Primarily inhabits ponderosa pine forests with an understory of Gambel oak. Tall pines used during all seasons for roosting. Also inhabits foothill shrublands (mountain mahogany), piñon-juniper woodlands, foothill riparian forests, and agricultural areas.

Source: CPW (2011a)

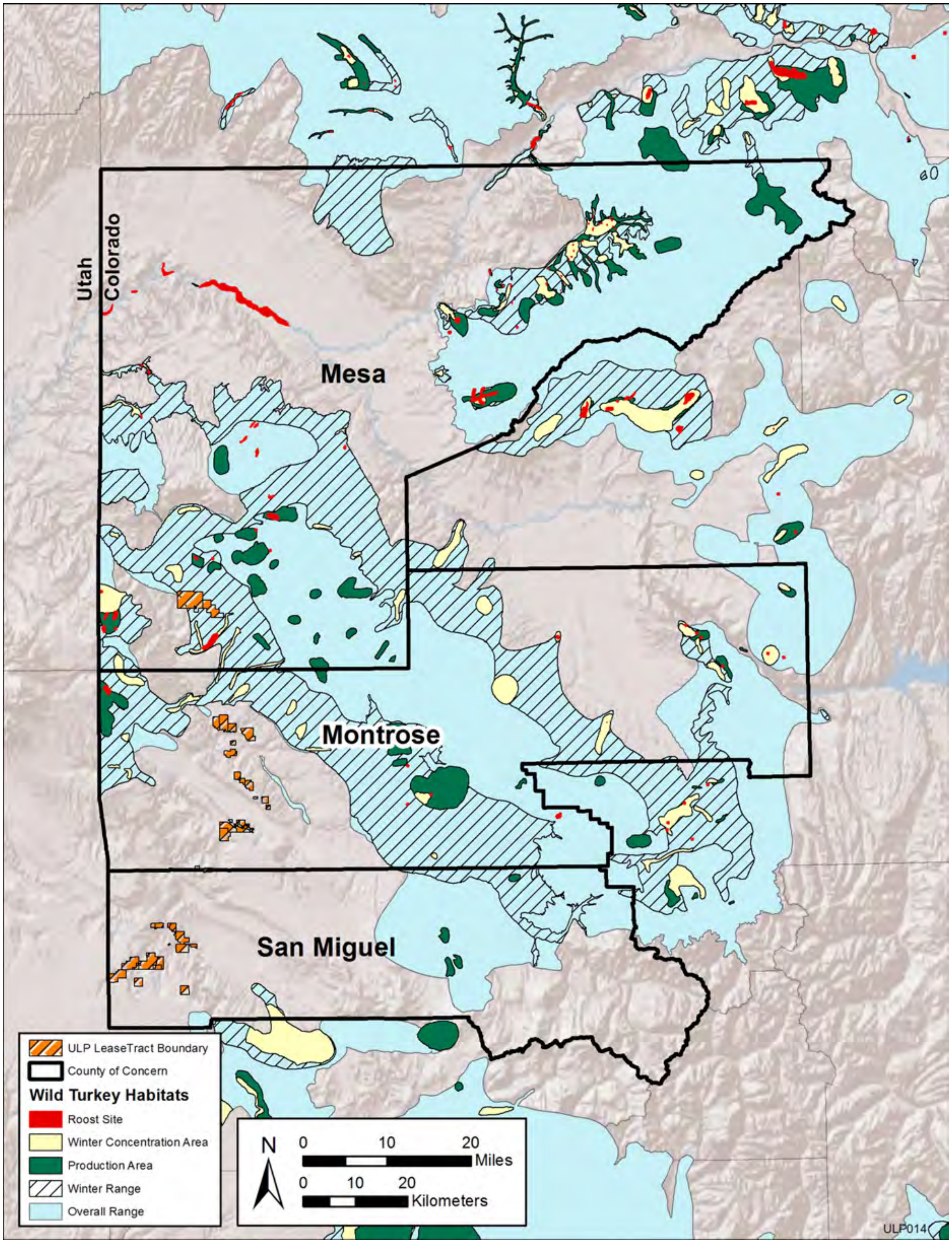


FIGURE 3.6-7 Wild Turkey Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

TABLE 3.6-11 Acreages of Wild Turkey Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	2,202,563	5,000	26, 27
Production area	125,555	0	None
Roost sites	11,020	0	None
Winter range	928,954	5,000	26, 27
Winter concentration area	62,694	0	None

Source: CPW (2011a)

- The Bald and Golden Eagle Protection Act provides for the protection of bald and golden eagles by prohibiting the take, possession, sale, purchase or barter, offer to sell, transport, export, or import of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb;” and “disturb” means “to agitate or bother an eagle to a degree that causes, or is likely to cause, injury; decrease in its productivity, by substantially interfering with normal breeding, feeding or sheltering behavior; or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior.” In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle’s return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment.

- Under E.O. 13186, each Federal agency that is taking an action that has or is likely to have negative impacts on migratory bird populations must work with the USFWS to develop an agreement to conserve those birds. The protocols developed by this consultation are intended to guide future agency regulatory actions and policy decisions.

3.6.2.3 Mammals

More than 80 mammal species occur in the three-county study area (Table 3.6-6). The following discussion emphasizes big game and other mammal species that (1) have key habitats within or near the lease tracts, (2) are important to humans (e.g., big and small game and furbearer species), and/or (3) are representative of other species that share important habitats. Threatened, endangered, and other special status mammal species are addressed in Section 3.6.4.

3.6.2.3.1 Big Game. The big game species within the three-county study area include American black bear (*Ursus americanus*), cougar (*Puma concolor*), desert bighorn sheep (*Ovis canadensis nelsoni*), elk (*Cervis canadensis*), moose (*Alces americanus*) mule deer (*Odocoileus hemionus*), and pronghorn (*Antilocapra americana*). Because the moose is located only in the far eastern and northern most portions of the three-county study area, it is geographically separated from the lease tracts; therefore, the species will not be addressed further in the ULP PEIS. A number of the big game species migrate when seasonal changes reduce food availability, when movement within an area becomes difficult (e.g., due to snow pack), or when local conditions are not suitable for calving or fawning. Established migration corridors provide important transition habitats between seasonal ranges and provide food sources for the animals during migration (Feeney et al. 2004). Maintaining genetic interchange through landscape linkages among subpopulations is also essential for the long-term survival of species. Maintaining migration corridors and landscape linkages, especially when seasonal ranges or subpopulations are far removed from each other, can be difficult because of the various land ownership mixes that often need to be traversed (Sawyer et al. 2005). Although migration corridors for the desert bighorn sheep, elk, and mule deer are present within the three-county study area, the lease tracts do not occur within those corridors.

Table 3.6-12 provides a description of the various activity areas that have been mapped for the big game species in Colorado. Table 3.6-13 provides habitat information for the big game species expected to occur within the lease tract boundaries.

The following presents a generalized overview of the big game species that inhabit the lease tracts.

American Black Bear. The American black bear occurs mostly within forested or brushy mountain environments and woody riparian corridors (UDWR 2008). It is considered secure in Colorado (common, widespread, and abundant) (NatureServe 2011). The omnivorous American black bear will feed on forbs and grasses, fruits and acorns, insects, small vertebrates, and carrion depending on their seasonal availability (CPW 2011a). Breeding occurs in June or July, with young born in January or February (UDWR 2008). American black bears are generally nocturnal and have a period of winter dormancy (UDWR 2008). They are locally threatened by habitat loss and disturbance by humans (NatureServe 2011). The home range size of American black bears varies, depending on the area and the bear's gender, and has been reported to be from about 1,250 to nearly 32,200 acres (500 to 13,000 ha) (NatureServe 2011).

TABLE 3.6-12 Descriptions of Big Game Activity Areas in Colorado

Activity Area	Activity Area Description
Concentration area	That part of the overall range where densities are at least 200% greater than they are in the surrounding area during a season other than winter.
Fall concentration area	That part of the overall range occupied from August 15 until September 30 for the purpose of ingesting large quantities of mast and berries to establish fat reserves for the winter hibernation period. Applies to the American black bear.
Migration corridor	Specific mappable site through which large numbers of animals migrate and the loss of which would change migration routes.
Overall range	Area that encompasses all known seasonal activity areas for a population.
Production area	That part of the overall range occupied by females from May 15 to June 15 for calving. Applies to ungulates.
Resident population area	Area used year-round by a population (i.e., an individual could be found in any part of the area at any time of the year).
Severe winter range	That part of the winter range where 90% of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum during the 2 worst winters out of 10. Applies to ungulates.
Summer concentration area	That portion of the overall range where individuals congregate from mid-June through mid-August.
Summer range	That portion of the overall range where 90% of the individuals are located between spring green-up and the first heavy snowfall.
Water source	Water sources known to be utilized (by bighorn sheep) in dry, water scarce areas. Up to a 1- mi radius described around a point source, and up to a 1-mi band along a river or stream.
Winter concentration area	That part of the winter range where densities are at least 200% greater than in the surrounding winter range during an average of 5 winters out of 10.
Winter range	That part of the overall range where 90% of the individuals are located during an average of 5 winters out of 10 from the first heavy snowfall to spring green-up.

Source: CPW (2011a)

TABLE 3.6-13 Habitat Information for Big Game Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
American black bear (*Ursus americanus*)	4,500–11,500	Montane shrublands and forests, and subalpine forests at moderate elevations. Dens in mixed conifer forests, piñon-juniper woodlands, spruce-fir forests, ponderosa pine forests, and oak shrublands.
Cougar (*Puma concolor*)	3,000–12,500	Most common in rough, broken foothills and canyon country, often in association with montane forests, shrublands, and piñon-juniper woodlands.
Desert bighorn sheep (*Ovis canadensis nelsoni*)	2,500–5,500 (winter) 6,000–10,000 (summer) Mainly 4,500–9,000 in project area	Vertical cliffs and sandstone rims to rolling flat desert valley bottoms dissected by gulches. Piñon-juniper and desert shrubs in canyons and mesas, aspen and ponderosa pine in upper drainages, and grasslands intermixed with oak brush, sagebrush, and juniper woodlands at intermediate elevations.
Elk (*Cervis canadensis*)	6,000–13,000	Semi-open forests or forest edges adjacent to parks, meadows, and alpine tundra.
Mule deer (*Odocoileus hemionus*)	3,000–13,000	All ecosystems from grasslands to alpine tundra. Highest densities in shrublands on rough, broken terrain, which provide abundant browse and cover.
Pronghorn (*Antilocapra americana*)	3,000–9,500	Grasslands and semidesert shrublands on rolling topography that affords good visibility. Most abundant in shortgrass or midgrass prairies, and least common in xeric habitats.

Sources: BLM and CDOW (1989); CPW (2011a); Streubel (2000); USGS (2007)

All the lease tracts occur within the overall range for the American black bear. Table 3.6-14 provides the acreage of the American black bear activity areas within the three-county study area and within the combined boundary for the lease tracts.

Cougar. Cougars (also known as mountain lions or puma) inhabit most ecosystems in the three-county study area but are most common in the rough, broken terrain of foothills and canyons, often in association with montane forests, shrublands, and piñon-juniper woodlands (CPW 2011a). They mostly occur in remote and inaccessible areas (NatureServe 2011). They are considered apparently secure in Colorado (uncommon but not rare, some cause for long-term concern due to declines or other factors) (NatureServe 2011). Their annual home range can be more than 560 mi^2 (1,450 km^2), while densities are usually not more than 10 adults per 100 mi^2

TABLE 3.6-14 Acreages of American Black Bear Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreages		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	4,377,502	25,909	All
Summer concentration area	645,821	0	None
Fall concentration area	759,012	0	None

Source: CPW (2011a)

(259 km^2) (NatureServe 2011). The cougar is generally found where its prey species (especially mule deer) are located. In addition to preying on deer, cougars prey upon most other mammals (which sometimes include domestic livestock) and some insects, birds, fishes, and berries (CPW 2011a). They are active year-round. Their peak periods of activity are within 2 hours of sunset and sunrise, although their activity peaks after sunset when they are near humans (NatureServe 2011; UDWR 2008). In some states, they are hunted on a limited and closely monitored basis (NatureServe 2011).

The overall range of the cougar covers the three-county study area, including all the lease tracts, and 122,000 acres (302,000 ha) of cougar peripheral range habitat occurs within Mesa County. Peripheral range is the part of the overall range where habitat is limited and populations are isolated. Population density may also be lower there than in the central part of the cougar's range (CPW 2011a). None of the tract leases in Mesa County is located near cougar peripheral range habitat.

Desert Bighorn Sheep. The bighorn sheep is considered apparently secure in Colorado (uncommon, but not rare, some cause for long-term concern due to declines or other factors) (NatureServe 2011).[16] The bighorn sheep is considered to be a year-long resident; it does not make seasonal migrations like elk and mule deer. Winter snow pack can limit the distribution and survival of bighorn sheep; therefore, during winter many of the larger herds in Colorado are associated with areas that receive warm, down slope, winter winds or low to mid-elevation cold desert habitats (George et al. 2009). Ewes move to reliable water courses or water sources during the lambing season, with lambing occurring on steep talus slopes within 1 mi to 2 mi (1.6 km to 3.2 km) of water. Bighorn sheep prefer open vegetation, such as low shrub, grassland, and other

[16] Within Colorado, there are two subspecies of bighorn sheep: the Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) and the desert bighorn sheep (*O. c. nelsoni*). The desert bighorn sheep, a BLM sensitive species (see Section 3.6.4), is the subspecies that inhabits areas within or near the lease tract boundaries.

treeless areas with steep talus and rubble slopes. Unsuitable habitats include open water, wetlands, dense forests, and other areas without grass understory (NatureServe 2011). Their annual home ranges can be up to 23 mi^2 (37 km^2) for males and 12 mi^2 to 17 mi^2 (19 to 27 km^2) for females (NatureServe 2011).

The diet of the bighorn sheep consists of shrubs, forbs, and grasses. In the early 1900s, bighorn sheep experienced significant declines due to disease, habitat degradation, and hunting. Threats to bighorn sheep include habitat changes resulting from fire suppression, interactions with feral and domestic animals, and human encroachment (NatureServe 2011). Bighorn sheep are very vulnerable to viral and bacterial diseases carried by livestock, particularly domestic sheep. Therefore, the BLM has adopted specific guidelines regarding domestic sheep grazing in or near bighorn sheep habitat. In appropriate locations, reintroduction efforts, coupled with water and vegetation improvements, have been conducted to restore bighorn sheep populations.

Thirty-six desert bighorn sheep were first introduced to Colorado from 1979 through 1981from translocations of individuals from Nevada and Arizona (BLM and CDOW 1989). The desert bighorn sheep occurs in the extreme western portion of the state within portions of Mesa, Montrose, San Miguel, and Dolores Counties. There are only four herds of desert bighorn sheep totaling about 325 individuals (in 2007). These herds occur in Game Management Units S56, S62, S63, and S64 (George et al. 2009). The population of desert bighorn sheep in Colorado falls short of the population objective of 1,200 individuals set by BLM and CDOW (1989). Respiratory disease, habitat quantity and quality, and cougar predation account for the failure to reach the population objective (George et al. 2009).

Figure 3.6-8 shows the activity areas for the desert bighorn sheep in the three-county study area (CPW 2011a). Within the study area, the desert bighorn sheep primarily inhabits areas along the Dolores, Gunnison, and lower Uncompahgre Rivers. Several of the lease tracts within the Uravan, Paradox, and Slick Rock Lease Tracts occur within the overall, winter, and summer ranges of the desert bighorn sheep; primarily of the 100 individuals of desert bighorn sheep in the two herds of Game Management Units S63 and S64 (George et al. 2009). Based on limited data collected for desert bighorn sheep with GPS collars, individuals have been recorded within lease tracts 9, 13A, 14, and 15 (CPW 2012b). Table 3.6-15 provides the acreage of the desert bighorn sheep activity areas within the three-county study area and within the combined boundary for the lease tracts.

Although there are no mapped migration corridors in the area of the lease tracts, data provided for desert bighorn sheep occurrence (CPW 2012b) demonstrate that Lease Tracts 13, 13A, and 14 provide a critical linkage point between the upper Dolores and middle Dolores desert bighorn sheep populations. Lease Tracts 15 and 15A are also important to the desert bighorn sheep, and Lease Tract 17 occurs in an area that seems to funnel desert bighorn sheep movements in the area. GPS collars on individual desert bighorn sheep in the Dolores River area have demonstrated that the area around Slick Rock is a significant movement corridor between the two desert bighorn sheep populations and may be where many of the sheep lamb and winter (CPW 2012b).

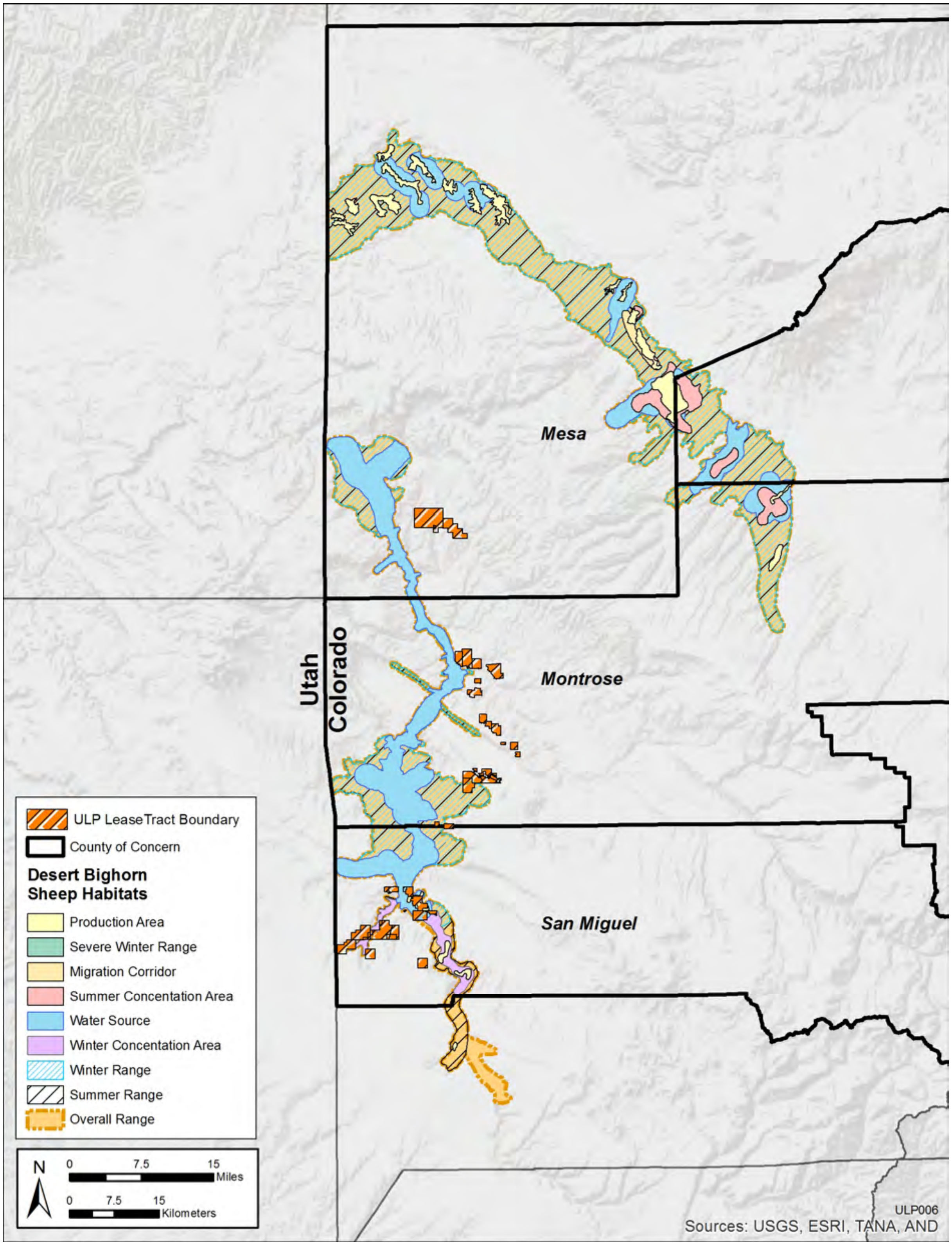


FIGURE 3.6-8 Desert Bighorn Sheep Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

TABLE 3.6-15 Acreages of Desert Bighorn Sheep Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	380,836	4,263	8, 9, 10, 11, 11A, 13, 13A, 14, 15, 16, 17, 19
Migration corridor	4,087	0	None
Production area	26,819	709	13, 13A, 14
Winter range	371,100	3,695	8, 9, 10, 11, 11A, 13, 13A, 16, 17, 19, 19A, 20
Winter concentration area	28,008	2,621	10, 11, 11A, 13, 13A, 16, 19A, 20
Severe winter range	0	0	None
Summer range	373,472	3,276	8, 9, 10, 11, 11A, 13, 13A, 14, 15, 16, 17, 19, 19A, 20
Summer concentration area	14,819	0	None
Water source	148,697	2,420	13, 13A14, 15, 19, 19A, 20

Source: CPW (2011a)

Elk. The elk is considered secure in Colorado (common, widespread, and abundant) (NatureServe 2011). Elk generally migrate between their summer and winter ranges, although some herds remain within the same area year-round (UDWR 2005). Their summer range occurs at higher elevations. Aspen and conifer woodlands provide security and thermal cover, while upland meadows, sagebrush/mixed grass, and mountain shrub habitats are used for forage. Their winter range occurs at mid to lower elevations, where they forage in sagebrush/mixed grass, big sagebrush/rabbitbrush, and mountain shrub habitats. They are highly mobile within both their summer and winter ranges as they search for the best forage conditions. In winter, they congregate into large herds of 50 to more than 200 individuals. The crucial winter range is considered to be the part of the local elk range where about 90% of the local population is located during an average of 5 winters out of 10 from the first heavy snowfall to spring. Elk calving generally occurs in aspen-sagebrush parkland vegetation and habitat zones during late spring and early summer. Calving areas are located mostly where cover, forage, and water are nearby. Migratory herds may move up to 60 mi (97 km) annually, while nonmigratory herds have a home range of 0.7 mi^2 to 2.0 mi^2 (1.8 km^2 to 5.3 km^2) (NatureServe 2011). Elk are susceptible to chronic wasting disease.

Figure 3.6-9 shows the activity areas for the elk in the three-county study area, and Figure 3.6-10 shows the various winter activity areas for the elk within the lease tracts (CPW 2011a). All the lease tracts occur within the overall range of the elk, and more than 70% of the lease tracts occur within the winter range and severe winter range habitats. Table 3.6-16 provides the acreage of the elk activity areas within the three-county study area and within the combined boundary for the lease tracts.

Mule Deer. Mule deer occur within most ecosystems in the three-county study area but attain their highest densities in shrublands characterized by rough, broken terrain with abundant browse and cover. The deer are considered secure in Colorado (common, widespread, and abundant) (NatureServe 2011). The size of their home range can vary from 74 to 590 acres (180 to 1,500 ha) or more, depending on the availability of food, water, and cover (NatureServe 2011). Some populations of mule deer are resident (particularly those that inhabit plains), but those in mountainous areas generally migrate between their summer and winter ranges (NatureServe 2011). In arid regions, they may migrate in response to rainfall patterns (NatureServe 2011). In mountainous regions, they may migrate more than 62 mi (100 km) between high summer and lower winter ranges (NatureServe 2011). Their summer range is at higher elevations that contain aspen and conifers and mountain browse vegetation. Fawning occurs during the spring while the mule deer are migrating to their summer range. This normally occurs in aspen-mountain browse intermixed vegetation.

Mule deer have a high fidelity to specific winter ranges, where they congregate within a small area at a high density. Their winter range is at lower elevations within sagebrush and piñon-juniper vegetation. Winter forage is primarily sagebrush, but Colorado birchleaf mountain-mahogany (*Cercocarpus montanus*), fourwing saltbush (*Atriplex canescens*), and antelope bitterbrush (*Purshia tridentata*) are also important. Piñon-juniper provides emergency forage during severe winters. Overall, mule deer habitat is characterized by areas of thick brush or trees (used for cover) interspersed with small openings (for forage and feeding areas); mule deer do best in habitats that are in the early stage of succession (UDWR 2003). Prolonged drought and other factors can limit mule deer populations. Several years of drought can limit forage production, which can substantially adversely affect the animals' condition and fawn production and survival. Severe drought conditions were responsible for declines in the population of mule deer in the 1980s and early 1990s. In arid regions, they are seldom found more than 1.0 to 1.5 mi (1.6 to 2.4 km) from water. Mule deer are also susceptible to chronic wasting disease. When the disease is present, up to 3% of a herd's population can be affected. Some deer herds in Colorado have experienced significant outbreaks of chronic wasting disease.

Figure 3.6-11 shows the activity areas for the mule deer in the three-county study area, and Figure 3.6-12 shows the various winter activity areas for the mule deer within the lease tracts (CPW 2011a). All the lease tracts occur within the overall range of the mule deer, and more than 70% of the lease tracts occur within mule deer winter range and severe winter range habitats. Table 3.6-17 provides the acreage of the mule deer activity areas within the three-county study area and within the combined boundary for the lease tracts.

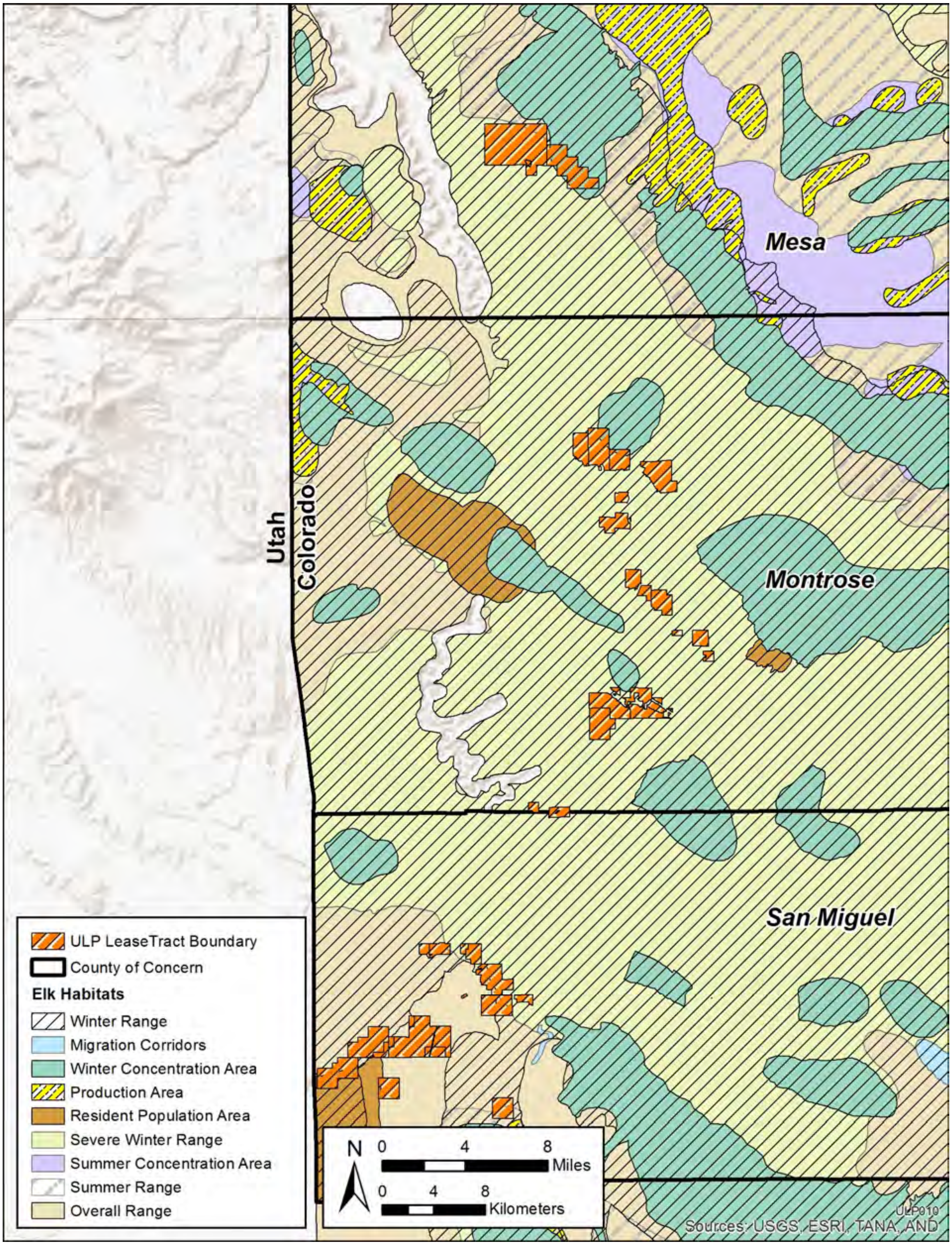


FIGURE 3.6-9 Elk Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

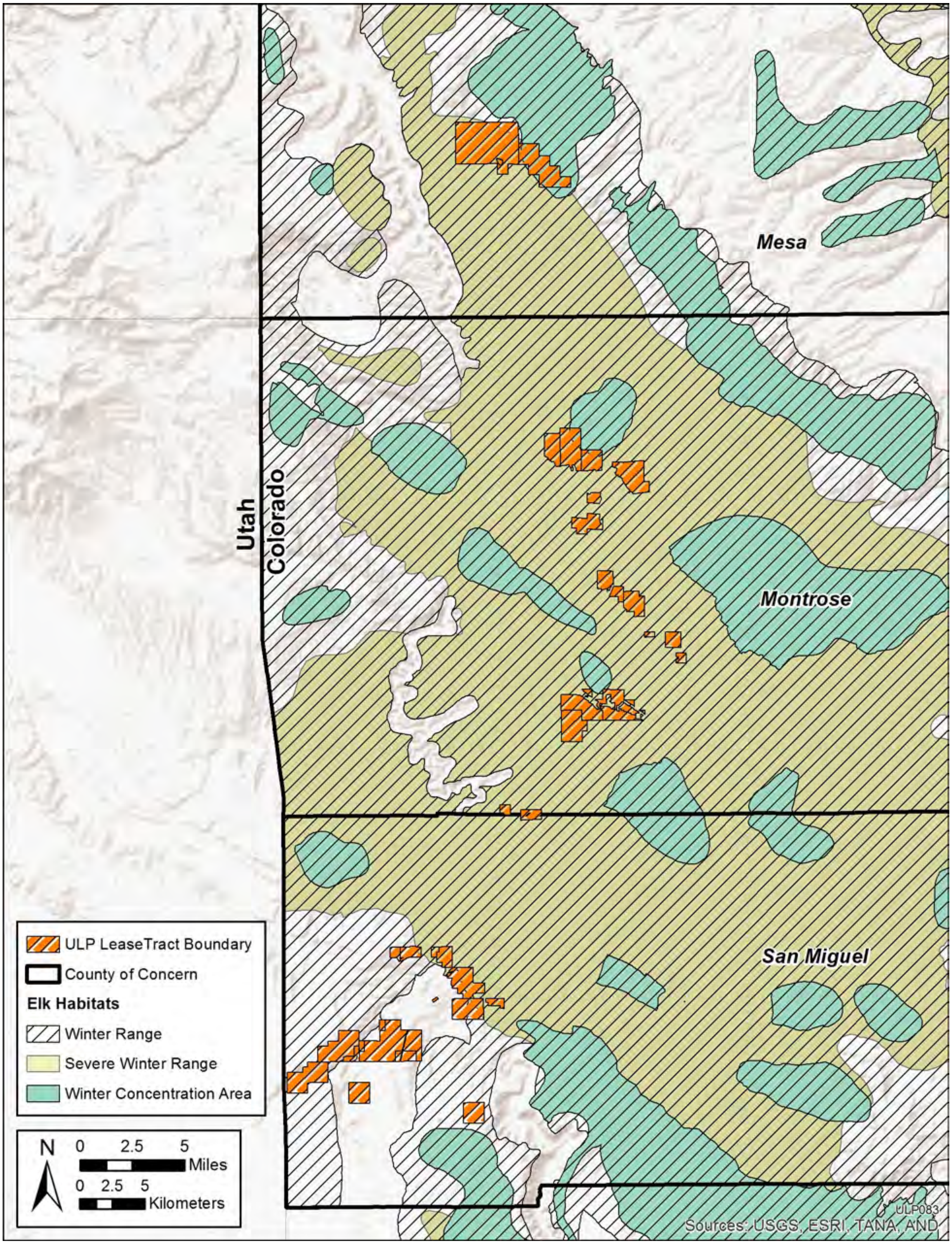


FIGURE 3.6-10 Elk Winter Activity Areas within the Lease Tracts (CPW 2011a)

TABLE 3.6-16 Acreages of Elk Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	3,859,070	25,909	All
Migration corridor	99,611	0	None
Production area	287,244	0	None
Winter range	2,515,281	16,371	5, 5A, 6, 7, 8, 8A, 9, 13, 13A, 14, 15, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27
Winter concentration area	533,978	1,994	7, 8A, 19A, 20, 26, 27
Severe winter range	1,155,714	16,846	5, 5A, 6, 7, 8, 8A, 9, 13, 13A, 14, 15, 17, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27
Summer range	1,531,501	1,060	12, 19A, 20, 26, 27
Summer concentration area	432,072	0	None
Resident population area	133,097	758	10, 11, 11A, 19A, 20

Source: CPW (2011a)

Pronghorn. Pronghorns inhabit nonforested areas such as desert, grassland, and sagebrush habitats. They are considered apparently secure in Colorado (uncommon but not rare, some cause for long-term concern due to declines or other factors) (NatureServe 2011). Herd size can commonly exceed 100 individuals, especially during winter. Pronghorns consume a variety of forbs, shrubs, and grasses, with shrubs being most important in winter. Some pronghorns are year-long residents and do not have seasonal ranges. Fawning occurs throughout the species range. However, some seasonal movement within their range occurs in response to factors such as extreme winter conditions and water or forage availability. Other pronghorns are migratory. Most herds range within an area 5 mi (8 km) or more in diameter, although the separation between summer and winter ranges has been reported to be as much as 99 mi (159 km) or more (NatureServe 2011). Pronghorn populations have been adversely affected in some areas by historic range degradation and habitat loss and by periodic drought conditions.

Figure 3.6-13 shows the activity areas for the pronghorn in the three-county study area (CPW 2011a). Only lease tract 13 occurs within pronghorn activity areas. Table 3.6-18 provides

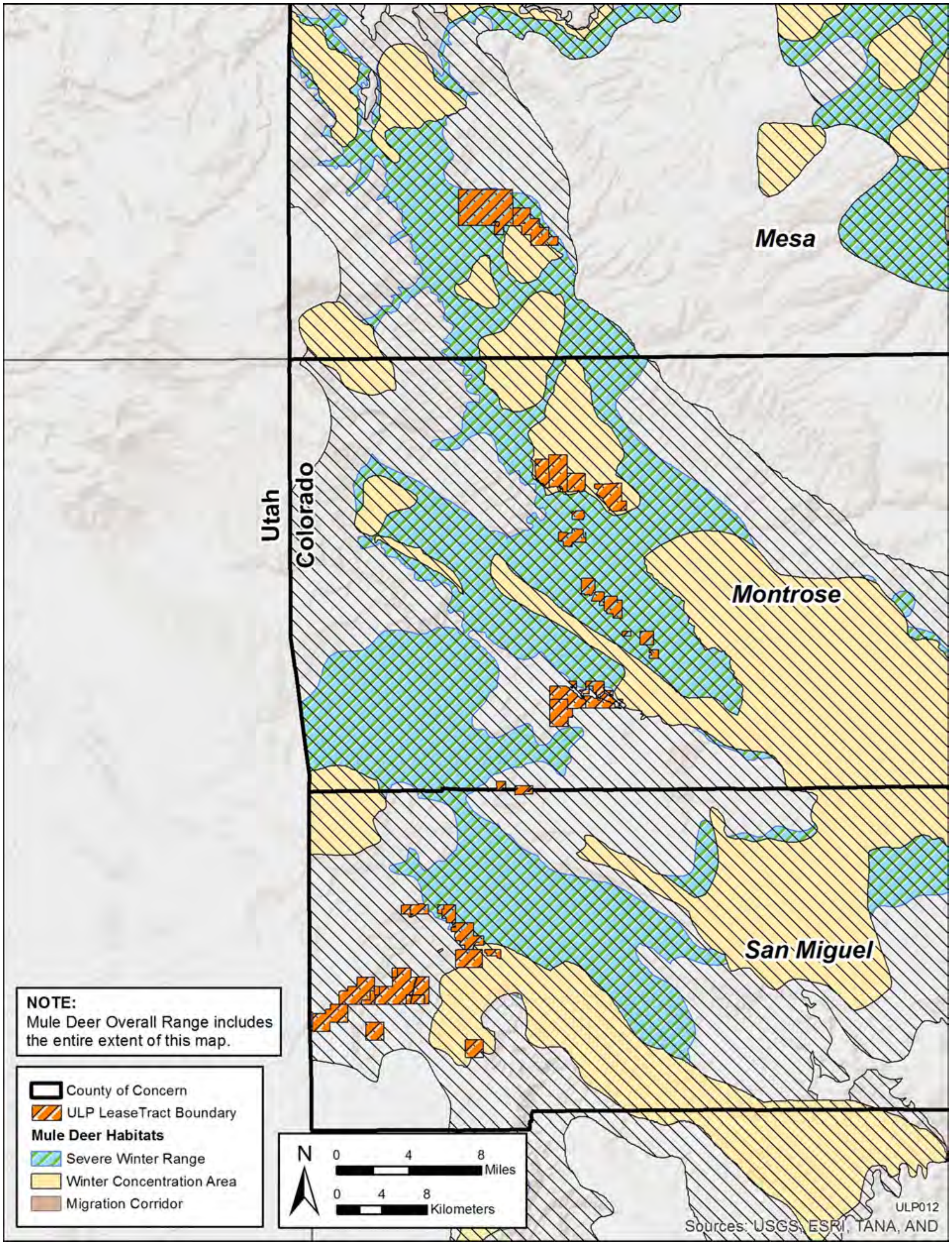


FIGURE 3.6-11 Mule Deer Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

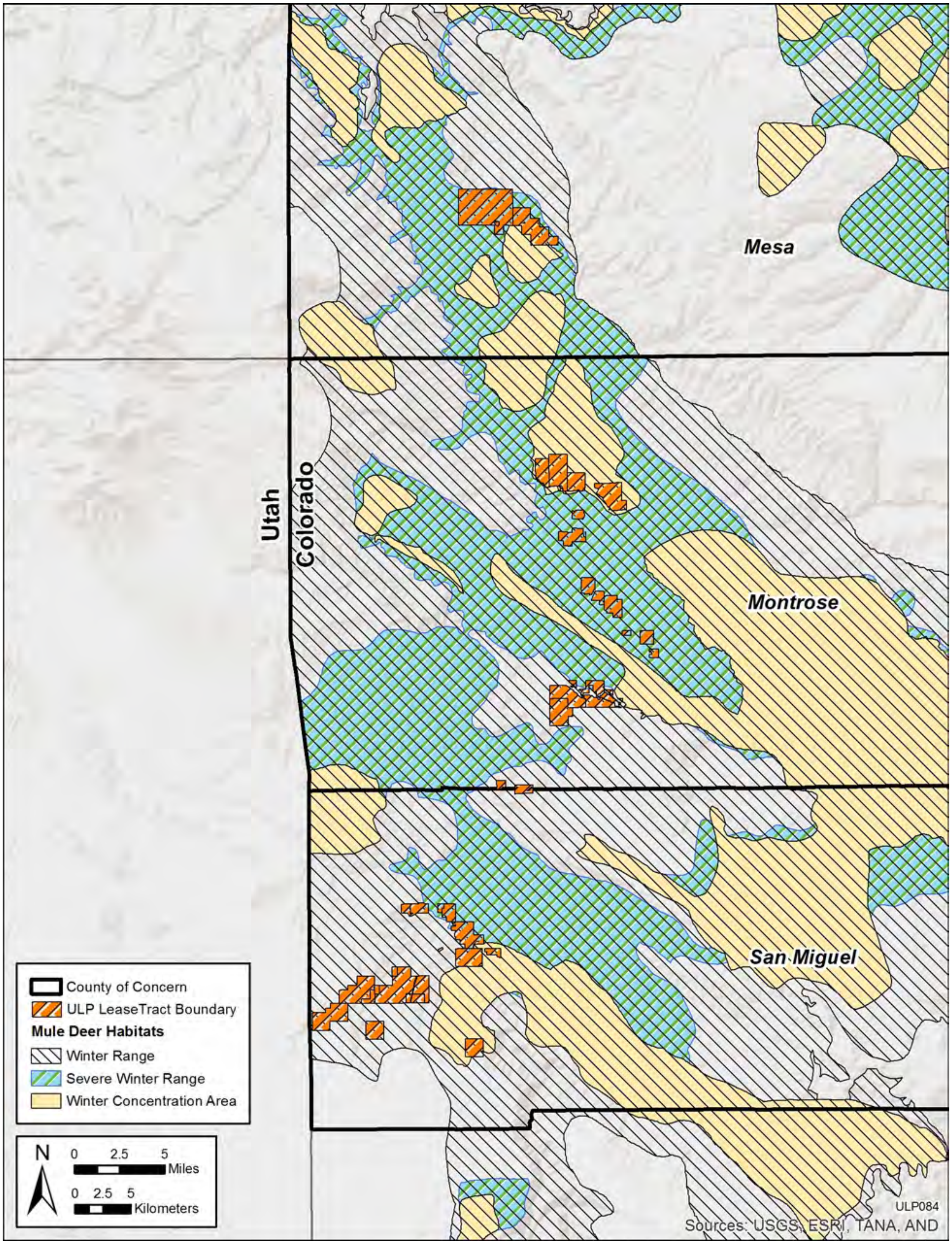


FIGURE 3.6-12 Mule Deer Winter Activity Areas within the Lease Tracts (CPW 2011a)

TABLE 3.6-17 Acreages of Mule Deer Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tracts
Overall range	4,389,942	25,909	All
Migration corridor	57,159	0	None
Winter range	2,583,851	25,909	All
Winter concentration area	690,210	5,817	5A, 12, 13, 14, 18, 19, 19A, 20, 26, 27
Severe winter range	1,186,029	14,524	5A, 7, 8A, 12, 13, 13A, 14, 15, 18, 19, 19A, 20, 21, 22, 22A, 23, 24, 25, 26, 27
Summer range	2,267,402	<1	27
Concentration area	155,470	0	None
Resident population area	487,478	656	10, 12

Source: CPW (2011a)

the acreage of the pronghorn activity areas within the three-county study area and within the combined boundary for the lease tracts.

3.6.2.3.2 Other Mammals. Other mammals that occur in the three-county study area include small game, furbearers, and nongame species. Small game species that occur within the three-county study area include black-tailed jackrabbit (*Lepus californicus*), white-tailed jackrabbit (*Lepus townsendii*), desert cottontail (*Sylvilagus audubonii*), mountain cottontail (*S. nuttallii*), squirrels (*Sciurus* spp.), snowshoe hare (*L. americanus*), and yellow-bellied marmot (*Marmota flaviventris*). Furbearers include American badger (*Taxidea taxus*), American marten (*Martes americana*), American beaver (*Castor canadensis*), bobcat (*Lynx rufus*), common muskrat (*Ondatra zibethicus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*). Nongame species include bats, shrews, mice, voles, chipmunks, and many other rodent species. Bats are of particular concern because their populations have declined in many parts of North America and because a number of bat species roost or hibernate in mines.

Nineteen species of bats occur in Colorado (Colorado Bat Working Group 2010a). Mining is one of the issue categories that affect bat populations in Colorado (Ellison et al. 2003).

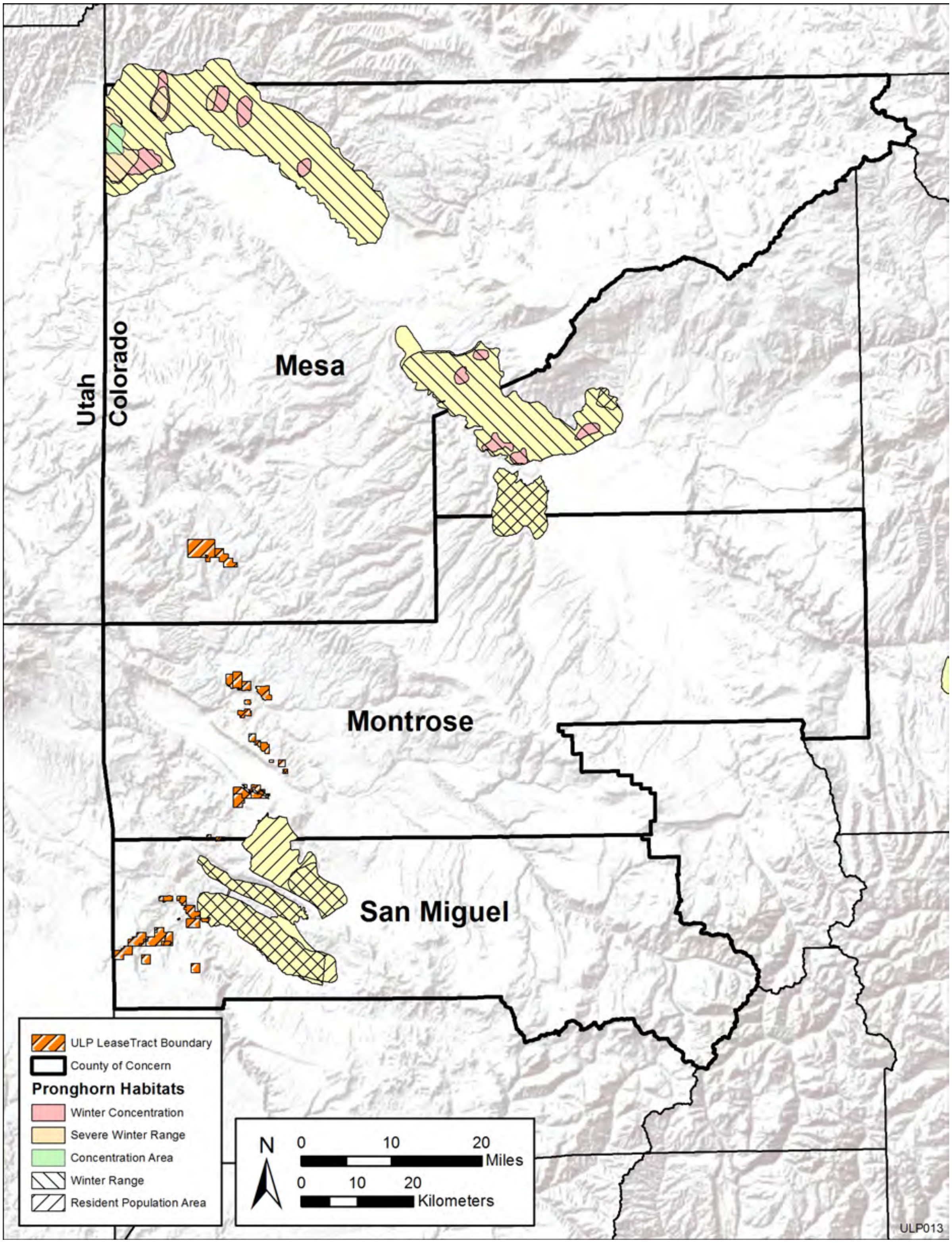


FIGURE 3.6-13 Pronghorn Activity Areas within the Three-County Study Area That Encompasses the Lease Tract Boundaries (CPW 2011a)

TABLE 3.6-18 Acreages of Pronghorn Activity Areas within the Three-County Study Area and the Combined Boundary for the Lease Tracts

	Acreage		
Activity Area	Three-County Study Area	Lease Tract Boundaries	Lease Tract
Overall range	290,431	30	13
Winter range	257,064	30	13
Winter concentration area	30,152	0	None
Severe winter range	15,469	0	None
Concentration area	3,551	0	None
Resident population area	93,020	30	13

Source: CPW (2011a)

As recreational caving and deforestation diminishes natural bat habitat, abandoned mines have increased in importance as roosting habitat. About 30% of the 23,000 abandoned mines in Colorado show signs of providing bat roosting habitat (Ellison et al. 2003). Abandoned mines surveyed in Lease Tracts 13, 13A, 14, 15, 16, 23, 26, and 27 have been observed to provide summer and/or winter roosting habitat for twelve bat species (Woodward 2012a,b; Table 3.6-19). The spotted bat (*Euderma maculatum*), fringed myotis (*Myotis thysanodes*), long-eared myotis (*M. evotis*), long-legged myotis (*M. volans*), western small-footed myotis (*M. ciliolabrum*), California myotis (*M. californicus*), and Yuma myotis (*M. yumanensis*) have been observed in abandoned uranium mines in Colorado (DOE 1995). Some of the DOE-reclaimed mine sites have bat gate closures to protect these bat habitats.

Table 3.6-20 provides habitat information for the small game, furbearer, and nongame mammal species expected to occur within the lease tract boundaries. Information on threatened, endangered, and other special status mammal species is provided in Section 3.6.4.

3.6.3 Aquatic Biota

The three-county study area contains a variety of freshwater aquatic habitats, which, in turn, support a wide diversity of aquatic biota. Aquatic habitats range in size and permanency from ephemeral ponds and streams to the Dolores and San Miguel Rivers. Sport fish in the three-county study area include trout (family Salmonidae), catfish (family Ictaluridae), sunfish and black basses (family Centrarchidae), suckers (family Catostomidae), perch and walleye (family

TABLE 3.6-19 Bat Species Reported from Abandoned Mines within the ULP Lease Tracts

Species	Lease Tract
Big brown bat (*Eptesicus fuscus*)	13A, 15, 16, 23, 26, 27
Big free-tailed bat (*Nyctinomops macrotis*)	13
California myotis (*Myotis californicus*)	13A, 14, 15, 16, 23, 26, 27
Fringed myotis (*Myotis thysanodes*)	14, 23, 26, 27
Little brown bat (*Myotis lucifugus*)	13
Long-eared myotis (*Myotis evotis*)	14, 26, 27
Long-legged myotis (*Myotis volans*)	13A, 14, 15, 23, 26, 27
Spotted bat (*Euderma maculatum*)	27
Townsend’s big-eared bat (*Corynorhinus townsendii*)	13, 13A, 14, 15, 16, 23, 26, 27
Western pipistrelle (*Pipistrellus hesperus*)	13
Western small-footed myotis (*Myotis ciliolabrum*)	13A, 14, 15, 16, 23, 26, 27

Source: Woodward (2012a)

Percidae), and pike (family Esocidae). In addition to fish, aquatic habitats also support a large variety of aquatic invertebrates, including crustaceans and insects.

Valdez et al. (1992) identified 11 orders of macroinvertebrates in the Dolores and San Miguel Rivers. Diptera (true flies), Ephemeroptera (mayflies), and Trichoptera (Caddisflies) made up more than 85% of the macroinvertebrates in the Dolores River and more than 70% of the macroinvertebrates in the San Miguel River. The crayfish *Orconectes virilis* was abundant in the Dolores River. Valdez et al. (1992) reported that macroinvertebrate diversity was very low in the Dolores and San Miguel Rivers in the 1970s and 1980s. Biotic Condition Index values for the Dolores and San Miguel Rivers for 1991 rated the rivers as excellent and fair to poor, respectively (Valdez et al. 1992).

Historically, only 12 species of fish were native to the Upper Colorado River Basin, including 5 minnow species, 4 sucker species, 2 salmonids, and the mottled sculpin (*Cottus bairdii*, family Cottidae). Four of these native species (humpback chub [*Gila cypha*], bonytail [*Gila elegans*], Colorado pikeminnow [*Ptychocheilus lucius*], and razorback sucker [*Xyrauchen texanus*]) are now Federally listed as endangered, and critical habitat for these species has been designated within the Upper Colorado River Basin (see Section 3.6.4). The roundtail chub (*Gila robusta*), bluehead sucker (*Catastomus discobolus*), and flannelmouth sucker (*Catastomus latipinnis*) (which occur in both the Dolores and San Miguel Rivers) are BLM-sensitive species, and the roundtail chub is also a Colorado species of special concern. See Section 3.6.4 for additional information on these species. In addition to native fish species, more than 25 non-native fish species are now present in the basin, often as a result of intentional introductions (e.g., for establishment of sport fisheries) (Muth et al. 2000; McAda 2003). Most of the trout species found within the Upper Colorado River Basin are introduced non-natives (e.g., rainbow trout [*Oncorhynchus mykiss*], brown trout [*Salmo trutta*], and some strains of cutthroat trout [*Oncorhynchus clarkii*]). However, the mountain whitefish (*Prosopium*

TABLE 3.6-20 Small Game, Furbearer, and Nongame Mammal Species Expected To Occur within the Lease Tract Boundaries

Species	Elevation (ft)	Habitat
Small Game and Furbearers		
American badger (*Taxidea taxus*)	4,500–14,500	Grasslands, meadows in subalpine and montane forests, alpine tundra, and semidesert shrublands.
Black-tailed jackrabbit (*Lepus californicus*)	3,000–7,000	Grasslands and semidesert shrublands.
Bobcat (*Lynx rufus*)	3,000–14,500	Most common in the rocky, broken terrain of foothills and canyonlands. Preferred habitats are piñon-juniper woodlands and montane forests, although it inhabits all terrestrial ecosystems.
Coyote (*Canis latrans*)	3,000–14,500	All terrestrial habitats, but least abundant in dense coniferous forests.
Desert cottontail (*Sylvilagus audubonii*)	3,000–7,000	Variety of habitats, including montane shrublands, riparian lands, semidesert shrublands, piñon-juniper woodlands, and various woodland-edge habitats. It will inhabit areas with minimal vegetation provided that adequate cover is present in the form of burrows, scattered trees and shrubs, or crevices and spaces under rocks.
Gray fox (*Urocyon cinereoargenteus*)	5,500–13,000	Usually rough, broken terrain in semidesert shrublands, montane shrublands, piñon-juniper and riparian woodlands, orchards, and weedy margins of croplands.
Long-tailed weasel (*Mustela frenata*)	3,000–14,500	All habitat types. Distribution is probably more dependent on availability of prey species than on vegetation or topography.
Mountain cottontail (*Sylvilagus nuttallii*)	6,000–11,500	Montane shrublands and semidesert shrublands and the edges of piñon-juniper woodlands and montane and subalpine forests. Also inhabits open parklands with sufficient shrub, rock, or tree cover.
Red fox (*Vulpes vulpes*)	3,000–14,500	Most common in open woodlands, pasturelands, and riparian and agricultural lands. Prefers areas with a mixture of these vegetation types. Also inhabits the margins of urbanized areas and is common in open spaces and other undeveloped areas adjacent to cities. In the mountains, it inhabits montane and subalpine meadows as well as in alpine and forest edges, usually near water.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Small Game and Furbearers (Cont.)		
Ringtail (*Bassariscus astutus*)	3,000–9,500	Arid and semiarid habitats. Typically associated with rocky canyon country and foothills areas of piñon-juniper woodlands, montane shrublands, and mixed conifer-oakbrush.
Striped skunk (*Mephitis mephitis*)	3,000–10,000	Wide range of grassland, shrubland, forestland, wetland, and riparian habitats.
Western spotted skunk (*Spilogale gracilis*)	4,000–8,000	Common in shrub habitats in broken country. Also inhabits montane forest and shrublands, semidesert shrublands, and piñon-juniper woodlands. Frequents rocky habitats.
White-tailed jackrabbit (*Lepus townsendii*)	4,000–14,500	Mostly semidesert shrublands, but also many grassland, shrubland, and forestland habitats.
Nongame (Small) Mammals		
Big brown bat (*Eptesicus fuscus*)	3,000–10,000	Variety of shrublands, forestlands, wetlands, and riparian areas. Roosts in dwellings and other structures, hollow trees, rock crevices, caves, under bridges, and in practically any other location that offers concealment and cover from the elements.
Botta's pocket gopher (*Thomomys bottae*)	4,000–8,500	Various vegetation types, including agricultural land, grasslands, roadsides, open parklands, piñon-juniper woodlands, open montane forest, montane shrublands, and semidesert shrublands.
Brazilian free-tailed bat (*Tadarida brasiliensis*)	3,000–9,500	Piñon-juniper woodlands, arid grasslands, and semidesert shrublands. Typically roosts in caves, mines, rock fissures, or buildings.
Brush mouse (*Peromyscus boylii*)	4,000–8,500	Montane shrublands, piñon-juniper woodlands, riparian cottonwood stands, willow thickets, and brushy salt-cedar (tamarisk) bottoms. Usually inhabits areas of rough, broken terrain with boulders and heavy brush.
Bushy-tailed woodrat (*Neotoma cinerea*)	4,500–14,000	Montane and subalpine forests, ponderosa pine forests, aspen communities, and alpine talus. Common around old mining camps and diggings at higher elevations. Also inhabits lower-elevation canyon country in semidesert shrublands, and in piñon-juniper woodlands, typically in rimrock, rock outcrops, and similar geologic features.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Nongame (Small) Mammals (Cont.)		
California myotis (*Myotis californicus*)	4,500–7,500	Most common in semidesert shrublands and piñon-juniper woodlands. Night roosts include abandoned structures, mines, caves, and cracks and crevices in cliff faces. Day roosts are similar but also include hollow trees and spaces under bark.
Canyon mouse (*Peromyscus crinitus*)	4,500–8,000	Inhabits talus and outwash rubble, or eroded, exposed sandstone. Habitat includes piñon-juniper woodlands and montane and semidesert shrublands.
Common porcupine (*Erethizon dorsatum*)	3,000–14,500	Associated with conifers in montane and subalpine forests and piñon-juniper woodlands. Also occupies cottonwood-willow forests in river bottoms, aspen groves, and semidesert shrublands.
Deer mouse (*Peromyscus maniculatus*)	3,000–14,000	Most native terrestrial habitats with cover except well-developed wetlands. Cover types include burrows of other animals, cracks and crevices in rocks, surface debris and litter, and human structures.
Golden-mantled ground squirrel (*Spermophilus lateralis*)	5,200–12,500	Open woodlands, shrublands, mountain meadows, and forest-edge habitat.
Hoary bat (*Lasiurus cinereus*)	3,000–10,000	Variety of riparian/wetland, shrubland, and forestland habitats.
Hopi chipmunk (*Tamias rufus*)	4,500–8,000	Canyon and slickrock piñon-juniper country. Highest densities found in areas with an abundance of broken rock or rubble at the base of cliff faces or in rock formations with deep fissures and crevices suitable for den sites.
Least chipmunk (*Tamias minimus*)	5,500–12,000	Low-elevation semidesert shrublands, montane shrublands and woodlands, forest edges, and alpine tundra.
Little brown myotis (*Myotis lucifugus*)	5,000–11,000	Roosts are under bark and rocks, in wood piles, buildings, and other structures, and less frequently in caves and mines.
Long-eared myotis (*Myotis evotis*)	4,000–9,000	Most common in ponderosa pine woodlands, also found in piñon-juniper woodlands and subalpine forests. Day roosts found in tree cavities, under loose bark, and in buildings. These sites, as well as caves and mines, are used for night roosts.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Nongame (Small) Mammals (Cont.)		
Long-legged myotis (*Myotis volans*)	4,000–12,500	Relatively common in ponderosa pine forests and piñon-juniper woodlands. Roosts in a variety of sites including trees, buildings, crevices in rock faces, and even fissures in the ground in severely eroded areas.
Mexican woodrat (*Neotoma mexicana*)	4,000–8,500	Rocky slopes and cliffs in montane shrublands, piñon-juniper woodlands, and montane forests. Usually dens and nests beneath ledges or in fissures of cliffs. Also uses abandoned or seasonally occupied buildings or mine tunnels.
Northern grasshopper mouse (*Onychomys leucogaster*)	4,500–8,000	Semiarid grasslands, sand hills, and open semidesert shrublands. Highest densities found on overgrazed rangelands, which typically have high populations of insects and numerous blowouts (patches of windblown soil) that are loose enough for burrowing and for dust bathing.
Northern pocket gopher (*Thomomys talpoides*)	5,000–14,500	Variety of habitats including agricultural and pasture lands, semidesert shrublands, and grasslands at lower elevations and upward into alpine tundra.
Ord's kangaroo rat (*Dipodomys ordii*)	3,000–8,000	Variety of habitats from semidesert shrublands and piñon-juniper woodlands to shortgrass or mixed prairie and silvery wormwood. Also dry, grazed, riparian areas if vegetation is sparse. Most common on sandy soils that allow for easy digging and construction of burrow systems.
Pallid bat (*Antrozous pallidus*)	3,000–7,000	Semidesert and montane shrublands, piñon-juniper woodlands, and riparian woodland in the foothills and canyon country. Day roosts are crevices and fissures in cliff faces, sallow caves and grottos, and buildings.
Piñon mouse (*Peromyscus truei*)	4,500–8,000	Piñon-juniper woodlands and occasionally sagebrush stands and rocky canyon country.
Rock squirrel (*Spermophilus variegatus*)	3,000–8,300	Mostly in piñon-juniper woodlands and montane shrublands in rocky hillsides, rimrock, and canyons. It requires boulders, talus, or dense tangles of vegetation under which it burrows.

TABLE 3.6-20 (Cont.)

Species	Elevation (ft)	Habitat
Nongame (Small) Mammals (Cont.)		
Silver-haired bat (*Lasionycteris noctivagans*)	4,500–9,500	Prefers forest edges. Forages over open areas or over streams and ponds. Generally uses tree cavities or crevices under loose bark for summer roosts but also uses buildings, caves, and woodpiles during migration or hibernation.
Western pipistrelle (*Pipistrellus hesperus*)	3,000–6,000	Canyon and desert country. Roosts under loose rocks, in crevices or caves, and occasionally in buildings. Also uses the burrows of animals in open desert scrub communities.
Western small-footed myotis (*Myotis ciliolabrum*)	4,000–8,500	In summer, it roosts in rock crevices, caves, dwellings, burrows, among rocks, under bark, and beneath rocks scattered on the ground. Generally found in the broken terrain of canyons and foothills, commonly in places with a cover of trees or shrubs.
White-tailed antelope squirrel (*Ammospermophilus leucurus*)	4,500–7,000	Semidesert shrublands, piñon-juniper woodlands, montane shrublands, and occasionally lowland riparian areas. Occupies burrows dug by other species such as kangaroo rats or small ground squirrels, but can also dig its own burrow under bushes, clumps of grasses, or at the base of trees, often in sandy soils near rock outcrops.
White-throated woodrat (*Neotoma albigula*)	3,000–7,000	Shrublands and piñon-juniper and juniper woodlands.
Yuma myotis (*Myotis yumanensis*)	3,000–6,000	Associated with riparian lands, although some of these areas may be relatively dry and shrubby. Day roosts are rock crevices, buildings, caves, and mines. Night roosts include buildings, under ledges, or similar shelters.

Sources: CPW (2011a); USGS (2007)

williamsoni) and Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) are native to the basin. Although the Colorado River cutthroat trout was once common within the upper Green River and upper Colorado River watersheds, it now occurs only in isolated subdrainages in Colorado, Utah, and Wyoming and is a species of concern in those states (Hirsch et al. 2006, see Section 3.6.4).

In 1990 and 1991, Valdez et al. (1992) collected 19 species of fish in the 180-mi (290-km) reach of the Dolores River between its confluence with the Colorado River and Bradfield Bridge (about 14 mi [22 km] downstream of McPhee Reservoir). Native fish collected included the Colorado pikeminnow, roundtail chub, flannelmouth sucker, bluehead sucker, speckled dace (*Rhinichthys osculus*), and mottled sculpin. The red shiner (*Cyprinella lutrensis*), sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*), common carp (*Cyprinus carpio*), and channel catfish (*Ictalurus punctatus*) were the most abundant non-native species. The other non-native species collected included the white sucker (*Catostomus commersonii*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), plains killifish *Fundulus zebrinus*), black bullhead (*Ameiurus melas*), channel catfish, brown trout, and rainbow trout (Valdez et al. 1992). Native species made up only 19% of the numbers of fish collected; however, this percentage is relatively higher here than it is in other upper Colorado River basins, indicating that predation and competition by non-native species was not a limiting factor for native fish species in the river system. Fish composition was similar to that found in a survey conducted in 1981, indicating that the fish community was somewhat stable over that 10-year period (Valdez et al. 1992).

Four Colorado pikeminnows were collected within 1.2 mi (2 km) of the confluence with the Colorado River. The species was reported in the lower 60 mi (100 km) of the Dolores River in the 1950s and 1960s. Although no Colorado pikeminnows were collected in the Dolores River in 1971 and 1981, there were unconfirmed reports of seven individuals collected in the lower 6 mi (10 km) of the San Miguel River in 1973 (Valdez et al. 1992). See Section 3.6.4 for additional information on the Colorado pikeminnow and other special status fish species.

Altered base flow releases from McPhee Dam (constructed in 1984 and located 200 mi [320 km] upstream of the Dolores River confluence with the Colorado River) accounted for reduced native fish habitat in the lower 170 mi (270 km) of the river, which resulted from decreased fish holding areas, dewatered nursery backwaters, impeded movement, and enhanced sedimentation (Valdez et al. 1992).

The Colorado Department of Wildlife (now Colorado Parks and Wildlife) collected fish from the Dolores River in Big Gypsum Valley near the Montrose/San Miguel County border (Anderson and Stewart 2003). This site is less than 1.5 mi (2.4 km) west of Lease Tract 17. A total of 13 fish species were collected in 2000, 2001, 2004, and 2005. These included four native species—flannelmouth sucker, bluehead sucker, roundtail chub, and speckled dace—and nine nonnative species—channel catfish, black bullhead, common carp, green sunfish, pumpkinseed (*Lepomis gibbosus*), red shiner, sand shiner, fathead minnow, and brown trout (Anderson and Stewart 2003). Increasing drought and sedimentation problems over the course of the study resulted in an increased number of black bullheads and a decreased number of flannelmouth suckers. Low-velocity pools that dominated the study area were favorable to bullhead and not favorable to native species. The absence of quality riffle habitats accounted for low numbers of bluehead suckers observed in the later years of the study (Anderson and Stewart 2003). Degraded or more silted riffle habitats observed after 2002 may have decreased invertebrate production and, as a result, caused the decreases observed for roundtail chub and channel catfish. The roundtail chub, flannelmouth sucker, and bluehead sucker appear to mature at a younger age and smaller size in the Dolores River than is typical in other larger rivers (Anderson and Stewart 2003). Several of the species may also occur in the tributary streams to the Dolores and San Miguel Rivers where flows are sufficient to provide habitat.

3.6.4 Threatened, Endangered, and Sensitive Species

A total of 52 species of plants and animals that are listed as threatened, endangered, or sensitive by state and Federal agencies may occur on or in the vicinity of the ULP lease tracts (Table 3.6-21). The known or potential distribution and habitat requirements for these species were determined from the USFWS Information, Planning, and Conservation System (IPaC) (USFWS 2011a), USFWS Critical Habitat Portal (USFWS 2011b), NatureServe Explorer (NatureServe 2011), Colorado Natural Heritage Program (CNHP) Rare Plant Guide List (CNHP 2011a), CNHP Element Occurrence Records (CNHP 2011b), CPW (2011a), and the Southwest Regional Gap Analysis Project (SWReGAP) (USGS 2007). The following types of species are considered in this assessment:

- Species that are listed as threatened or endangered under the ESA, or that are proposed or candidates for listing under the ESA;
- Species that are listed by the BLM as sensitive;
- Species that are listed by the U.S. Forest Service (USFS) as sensitive;
- Species that are listed as threatened or endangered by the State of Colorado.

3.6.4.1 Species Listed under the Endangered Species Act

Of the 10 ESA-listed, proposed, and candidate species that may occur in the vicinity of the ULP lease tracts, 7 are ESA-listed as threatened or endangered and 3 are candidates for listing (Table 3.6-21). The following definitions are applicable to the species listing categories under the ESA:

- *Endangered:* Any species that is in danger of extinction throughout all or a significant portion of its range.
- *Threatened:* Any species that is likely to become endangered within the foreseeable future throughout all or a significant part of its range.
- *Proposed for listing:* Species that has been formally proposed for listing by the USFWS by a notice in the *Federal Register*.[17]

[17] Within 1 year of a proposal for listing, the USFWS or National Marine Fisheries Service (NMFS) must take one of three possible courses of action: (1) finalize the listing rule (as proposed or revised); (2) withdraw the proposal if the biological information on hand does not support the listing; or (3) extend the proposal for up to an additional 6 months because, at the end of 1 year, there is substantial disagreement within the scientific community concerning the biological appropriateness of the listing. After the extension, the USFWS or NMFS must make a decision on whether to list the species on the basis of the best scientific information available.

TABLE 3.6-21 Threatened, Endangered, and Sensitive Species That May Occur in the Vicinity of the ULP Lease Tracts

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Plants			
Canyonlands biscuitroot	*Aletes latilobus*	BLM-S	In Colorado, known only from Mesa County. Inhabits piñon-juniper and desert shrub communities on sandy soils derived from the Entrada Formation. Elevation range is 5,000–7,000 ft. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa County.
Dolores River skeletonplant	*Lygodesmia doloresensis*	BLM-S	Juniper-desert shrub or juniper-grassland communities on alluvial soils derived from sandstone outcrops associated with the undivided lower portion of the Cutler Group. Elevation range is 4,400–4,700 ft. Known occurrences of habitat for this species on Lease Tract 13; quad-level occurrences for this species also intersect Lease Tract 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Eastwood's monkeyflower	*Mimulus eastwoodiae*	BLM-S	Shallow caves and seeps on steep canyon walls. Elevation range is 4,700–5,800 ft. Known to occur in western Mesa, Montrose, and San Miguel Counties. Quad-level occurrences intersect Lease Tracts 11, 13, 13A, 14(1), 14(2), 15, 15A, 16, 16A, 18, 19, 19A, 20, 24, and 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Fisher milkvetch	*Astragalus piscator*	BLM-S	In Colorado, known only from Mesa County on sandy, sometimes gypsiferous, soils of valley benches and gullied foothills. Elevation range is 4,300–5,600 ft. Quad-level occurrences intersect Lease Tract 26 in Mesa County. Suitable habitat could occur on or near lease tracts in Mesa County.
Grand Junction milkvetch	*Astragalus linifolius*	BLM-S	Grows on the Chinle and Morrison Formations, with piñon-juniper and sagebrush. Elevation range is 4,800–6,200 ft. Known to occur in Mesa and Montrose Counties. Quad-level occurrences intersect Lease Tracts 19, 19A, 20, 21, 22, 23(1), 23(2) 23(3), 24, 26, and 27. Suitable habitat could occur on or near lease tracts in Mesa and Montrose Counties.
Grand Junction suncup	*Camissonia eastwoodiae*	BLM-S	Occurs in adobe hills in the lower valleys of western Colorado. Inhabits saltbush, shadscale, blackbrush, and juniper communities at 3,900–5,900 ft. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa County.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Plants (Cont.)			
Gypsum Valley cateye	*Cryptantha gypsophila*	BLM-S	Endemic to western Colorado. Inhabits gypsum outcrops. Quad-level occurrences intersect Lease Tracts 12, 13, 14(1), and 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Helleborine	*Epipactis gigantea*	BLM-S; FS-S	Inhabits seeps on sandstone cliffs and hillsides; also occurs along springs. Elevation range is 4,800–8,000 ft. Quad-level occurrences intersect Lease Tracts 18, 19, 19A, 20, and 24. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Horseshoe milkvetch	*Astragalus equisolensis*	BLM-S	In Colorado, known only from Mesa County. Occurs in shrubland communities. Quad-level occurrences intersect Lease Tract 26. Suitable habitat could occur on or near lease tracts in Mesa County.
Kachina daisy	*Erigeron kachinensis*	BLM-S	Endemic to the Colorado Plateau in western Colorado and eastern Utah. Inhabits saline soils in alcoves and seeps in canyon walls. Elevation range is 4,800–5,600 ft. Quad-level occurrences intersect Lease Tracts 18, 19, 19A, 20, and 24. Suitable habitat could occur on or near lease tracts in Montrose County.
Naturita milkvetch	*Astragalus naturitensis*	BLM-S	Inhabits sandstone mesas, ledges, crevices, and slopes in piñon-juniper woodlands. Elevation range is 5,000–7,000 ft. Known occurrences and habitat for this species are on Lease Tract 13, near Paradox Valley, and near Uravan. Quad-level occurrences also intersect Lease Tracts 6, 7, 8, 8A, 9, 12, 13, 13A, 14(1), 14(2), 15, 15A, 17(1), 17(2), 18, 19, 19A, 20, and 24. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Osterhout's cryptantha	*Cryptantha osterhoutii*	BLM-S	Known from Mesa County, Colorado, as well as eastern Utah. Inhabits dry, barren sites, on sandstone substrates. Elevation range is 4,500–6,100 ft. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa County.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Plants (Cont.)			
Paradox breadroot	*Pediomelum aromaticum*	BLM-S	Known from adobe hills in Mesa and Montrose Counties, Colorado. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Paradox lupine	*Lupinus crassus*	BLM-S	Endemic to western Montrose County, Colorado. Inhabits piñon-juniper woodlands or clay barrens along draws and washes with sparse vegetation. Elevation range is 5,000–8,000 ft. Occurs near Paradox Valley lease tracts and near Uravan. Quad-level occurrences also intersect Lease Tracts 18, 21, 22, 22A, 23(1), 23(2), 23(3), 24, and 25. Suitable habitat could occur on or near lease tracts in Montrose County.
San Rafael milkvetch	*Astragalus rafaelensis*	BLM-S	Inhabits hillsides, washes, and talus under cliffs on clay, silty, or sandy substrates. Elevation range is 4,400–6,500 ft. Known to occur near Uravan lease tracts. Quad-level occurrences intersect Lease Tracts 5, 5A, 6, 7, 8, 8A, 9, 18, 19, 19A, 20, 22, 22A, 24, 26, and 27. Suitable habitat could occur on or near lease tracts in Mesa and Montrose Counties.
Sandstone milkvetch	*Astragalus sesquiflorus*	BLM-S	Occurs on sandstone rock ledges, fissures of domed siltrock, talus, and sometimes in sandy washes. Elevation range is 5,000–5,500 ft. Quad-level occurrences intersect Lease Tracts 5, 5A, 6, 7, 8, 8A, 9, 18, 19, 19A, 20, 22, 22A, and 24. Suitable habitat could occur on or near lease tracts in Montrose County.
Wetherill's milkvetch	*Astragalus wetherillii*	FS-S	Occurs on steep slopes, canyon benches, and talus under cliffs. Elevation range is 5,250–7,400 ft. Quad-level occurrences intersect Lease Tracts 5, 5A, 6, and 7. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Invertebrates			
Great Basin silverspot butterfly	*Speyeria nokomis nokomis*	BLM-S	Inhabits streamside meadows, open seepage areas, and other riparian areas with an abundance of violets. Not known to occur in any lease tracts, but suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.
Fish			
Bluehead sucker	*Catostomus discobolus*	BLM-S; FS-S	Found in a variety of aquatic habitats from headwater streams to large rivers. The bluehead sucker requires water moving at a moderate to fast velocity, preferably over rock substrates. This species does not occur on any of the lease tracts; however, it could occur in the Dolores and San Miguel Rivers, which are downstream of lease tracts in Mesa, Montrose, and San Miguel Counties; the Dolores River flows through portions of Lease Tracts 13A, 13, and 14. It is most common in the Dolores River downstream of the confluence with the San Miguel River.
Bonytail chub	*Gila elegans*	ESA-E; CO-E	Found historically throughout the Colorado River drainage; currently known only from the Green River in Utah and Lakes Havasu and Mohave. Inhabits large river systems in eddies and pools. The bonytail chub does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Colorado pikeminnow	*Ptychocheilus lucius*	ESA-E; CO-T	Restricted to large rivers of the Colorado River basin. The Colorado pikeminnow does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Flannelmouth sucker	*Catostomus latipinnis*	BLM-S; FS-S	Inhabits moderate to large rivers, is seldom in small creeks, and is absent from impoundments. Prefers pools and deep runs. Spawns in riffles, usually over a substrate of coarse gravel. In Colorado, the flannelmouth is found only in large rivers on the western slope. This species does not occur on any of the lease tracts; however, it could occur in the Dolores and San Miguel Rivers, which are downstream of lease tracts in Mesa, Montrose, and San Miguel Counties; the Dolores River flows through portions of Lease Tracts 13A, 13, and 14.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Fish (Cont.)			
Humpback chub	*Gila cypha*	ESA-E; CO-T	Historically ranged throughout the Colorado River system. Current distribution in Colorado is limited to the Yampa, Gunnison, Green, and Colorado Rivers in the western portion of the state. Inhabits slow eddies and pools over rock, sand, or gravel substrates. The humpback chub does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Razorback sucker	*Xyrauchen texanus*	ESA-E; CO-E	Historically ranged throughout the Colorado River system. Current distribution in Colorado is limited to the lower mainstem Colorado, Gunnison, lower Yampa, and Green Rivers. The razorback sucker does not occur on any of the lease tracts; however, it could inhabit the Colorado River downstream from the confluence of the Dolores River, which flows through Lease Tracts 13A, 13, and 14 approximately 70 mi upstream.
Roundtail chub	*Gila robusta*	BLM-S; FS-S	Found in the Colorado River mainstem and larger tributaries. Prefers slow-moving waters adjacent to areas of faster water. The roundtail chub does not occur on any of the lease tracts; however, it could inhabit downstream areas, including the Dolores River, which flows through Lease Tracts 13A, 13, and 14. It is the most abundant native fish species in the downstream reaches of the Dolores River.
Amphibians			
Boreal toad	*Bufo boreas*	CO-E	Generally associated with montane riparian habitats at elevations from 8,500–11,500 ft. Habitats include marshes, meadows, streams, beaver ponds, and lakes. Not known to occur on or near any of the lease tracts and suitable habitat is not likely to occur on the lease tracts. However, according to the SWReGAP habitat model, potentially suitable habitat may occur in the vicinity of the Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (19, 26, and 27).
Canyon treefrog	*Hyla arenicolor*	BLM-S	Occurs along intermittent streams in deep, rocky, canyons. Elevation typically ranges from 4,500–6,300 ft. Quad-level occurrences for this species intersect Lease Tracts 6, 7, 8, 8A, 9, 11, 13, 13A, 14(1), 14(2), 15, 15A, 16, 16A, and 26. Suitable habitat could occur on or near lease tracts in Mesa, Montrose, and San Miguel Counties.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Amphibians (Cont.)			
Great Basin spadefoot	*Spea intermontana*	BLM-S	Inhabits piñon-juniper woodlands, sagebrush communities, and semidesert shrublands at elevations generally below 7,000 ft. Not known to occur in any lease tracts. However, according to the SWReGAP habitat model, potentially suitable habitat could occur within 1 mile to the west of Lease Tracts 11 and 11A.
Northern leopard frog	*Rana pipiens*	BLM-S; FS-S	Inhabits wet meadows, marshes, ponds, lakes, and reservoirs, as well as streams and irrigation ditches. Elevation range is 3,000–11,000 ft. Not known to occur in any lease tracts, and suitable habitat does not occur on the lease tracts. However, according to the SWReGAP habitat model, potentially suitable habitat could occur in the vicinity of Uravan lease tracts (18, 19, 19A, 24, and 25) and lease tracts in the Slick Rock area (13, 13A, 14, 15, and 15A).
Reptiles			
Longnose leopard lizard	*Gambelina wislizenii*	BLM-S	Inhabits flat or gently sloping shrublands in sparse vegetation. Quad-level occurrences intersect Lease Tract 26. According to the SWReGAP habitat model, potentially suitable habitat could occur on or near Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (18, 19, 19A, 20, 24, 26, and 27).
Midget-faded rattlesnake	*Crotalus oreganus concolor*	BLM-S	Quad-level occurrences for this species intersect Lease Tracts 26 and 27. According to the SWReGAP habitat model, potentially suitable habitat for this species occurs on or near all lease tracts.
Birds			
Bald eagle	*Haliaeetus leucocephalus*	BLM-S; FS-S	Preferred habitat includes reservoirs and large rivers. In winter, bald eagles may occur locally in semidesert and grassland habitats, especially near prairie dog towns. May forage in arid shrubland environments. Bald eagles winter in riparian habitat along the Dolores River and in Dry Creek Basin. A winter nocturnal roost area is located in the Slick Rock area. Eagles probably forage for carrion in deer and elk winter concentration areas such as Atkinson Mesa (Lease Tracts 18, 19, 19A and 20), The Slick Rock area (Lease Tracts 13, 13A, and 14), Paradox Valley (Lease Tracts 21, 22A, and 23A), Monogram Mesa (Lease Tracts 5, 6, 7, 7A, 8, and 9), and Calamity Mesa (Lease Tracts 26, 26A, 27, and 27A).

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Birds (Cont.)			
Brewer's sparrow	*Spizella breweri*	BLM-S	A summer resident on mesas and foothills of western Colorado; occurs primarily in sagebrush shrublands but also occurs in mountain mahogany communities. Not known to occur in any lease tracts; however, according to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Burrowing owl	*Athene cunicularia*	BLM-S; CO-T	A year-round resident in western Colorado in grasslands near prairie dog towns. This species may occur in association with prairie dog towns on or near the Gateway lease tracts (26 and 27). According to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Ferruginous hawk	*Buteo regalis*	BLM-S; FS-S	A winter resident in western Colorado in grasslands and semidesert shrublands. Occasionally found in piñon-juniper woodlands. Winter residents concentrate around prairie dog towns. This species may use portions of the lease tracts during winter migration. According to the SWReGAP habitat model, potentially suitable winter habitat could occur on or near all lease tracts.
Gunnison sage-grouse	*Centrocercus minimus*	ESA-P; BLM-S; FS-S	Inhabits sagebrush shrublands, but will sometimes occur in meadows, grasslands, and thickets adjacent to sagebrush communities. A portion of the proposed occupied critical habitat for this species is within 1 mi (1.6 km) south of Lease Tracts 6, 8, and 9. Potential proposed critical habitat intersects several lease tracts in the Slick Rock area (Lease Tracts 10, 11, 11A, 12, 15A, 16, and 16A).
Mexican spotted owl	*Strix occidentalis lucida*	ESA-T; CO-T	Inhabits large steep canyons with dense old-growth mixed coniferous forest. Quad-level occurrences for this species intersect Lease Tract 12. However, suitable habitat for this species does not occur on any of the lease tracts. According to the SWReGAP habitat model for the spotted owl (*S. occidentalis*), potentially suitable migratory habitat may occur on all lease tracts.
Northern goshawk	*Accipiter gentilis*	BLM-S; FS-S	A rare migrant and winter resident in western Colorado, the northern goshawk inhabits various forest types including coniferous, piñon-juniper, and riparian habitats. May also forage in shrubland areas. According to the SWReGAP habitat suitability model, potentially suitable year-round habitat may occur on or near all lease tracts. Although the lease tracts may provide foraging habitat, it is unlikely that the lease tracts provide any nesting habitat for this species.

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Birds (Cont.)			
Peregrine falcon	*Falco peregrinus*	BLM-S; FS-S	A summer breeding resident in western Colorado, this species occurs near cliffs and bluffs that overlook grasslands and shrublands. Breeding birds nest on cliff faces. Quad-level occurrences for this species intersect Lease Tracts 12, 22, 22A, 24, 25, and 26. Nesting is known to occur close to Paradox Valley lease tracts. According to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Sage sparrow	*Amphispiza belli*	FS-S	Local and irregular summer resident on mesas of western Colorado. Breeds in sagebrush shrublands. Quad-level occurrences for this species intersect Lease Tracts 5, 5A, 6, 7, 8, 8A, 9, 18, 19, 19A, 20, 22, 22A, 24, and 25. According to the SWReGAP habitat model, potentially suitable summer breeding habitat could occur on or near all lease tracts.
Southwestern willow flycatcher	*Empidonax traillii extimus*	ESA-E; CO-E	An uncommon summer resident in western Colorado. Breeds in montane riparian thickets dominated by willow. Not known to occur in any of the lease tracts; however, potentially suitable breeding habitat could occur along the Dolores and San Miguel Rivers, which are downstream from lease tracts in Mesa, Montrose, and San Miguel Counties; the Dolores River also flows through portions of Lease Tracts 13A, 13, and 14.
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	ESA-C; BLM-S; FS-S	An uncommon summer breeding resident in western Colorado. Inhabits riparian woodlands, particularly those consisting of cottonwood and willow. Not known to occur on any of the lease tracts. According to the SWReGAP habitat model, potentially suitable breeding habitat may occur along the Dolores River in southern Mesa County and northern Montrose County, downstream from the Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (18, 19, 19A, 20, 24, 25, 26, and 27). Potentially suitable habitat may occur on or near other lease tracts along the Dolores and San Miguel Rivers.
White-faced ibis	*Plegadis chihi*	BLM-S; FS-S	A rare fall migrant in western Colorado, this species inhabits wet meadows, marshlands, and reservoir shorelines. This species is not known to occur on any of the lease tracts. According to the SWReGAP habitat model, however, potentially suitable migratory habitat could occur on or near some Slick Rock area lease tracts (13, 13A, 14, 15, and 15A).

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Mammals			
Big free-tailed bat	*Nyctinomops macrotis*	BLM-S; FS-S	Forages primarily on moths in a variety of habitats, including montane forests and shrublands. Roosts in crevices on cliff faces or in buildings. Known to occur at Lease Tracts 8 and 13. According to the SWReGAP habitat model, potentially suitable year-round habitat intersects all lease tracts.
Black-footed ferret	*Mustela nigripes*	ESA-E; ESA-XN; CO-E	Believed to be extirpated from the state of Colorado since the 1950s. Experimental populations were reintroduced to the northwestern portion of Colorado beginning in 2001. Historically, it inhabited prairies and semiarid shrublands, where it preyed on prairie dogs. According to the SWReGAP habitat model, potentially suitable habitat does not occur near any lease tracts; however, this species could occur on or near some lease tracts that support prairie dog towns.
Fringed myotis	*Myotis thysanodes*	BLM-S	A snag-dependent bat species that occurs in a wide variety of forest types including ponderosa pine, oak, and piñon-juniper. Also forages in grasslands and shrublands. Roosts in snags and rock crevices. Known to occur at Lease Tracts 14, 23, 26, and 27. According to the SWReGAP habitat model, potentially suitable year-round habitat intersects all lease tracts.
Gunnison’s prairie dog	*Cynomys gunnisoni*	ESA-C; BLM-S; FS-S	In Colorado, this species is restricted to the southwestern and south-central portion of the state. Inhabits grasslands and semiarid shrublands. According to CPW, this species is known to occur in at least one lease tract and suitable habitat may occur in several other lease tracts in Montrose and San Miguel Counties. The overall range for this species intersects several Paradox and Uravan lease tracts.
Desert bighorn sheep	*Ovis canadensis nelsoni*	BLM-S; FS-S	Inhabits visually open, steep, rocky terrain in mountainous habitats of the southwestern United States. Rarely uses valleys and lowlands, except as travel corridors between mountain ranges. Known to occur in Lease Tracts 9, 13, 13A, 14, and 15. According to the SWReGAP habitat suitability model, however, potentially suitable habitat for this species could occur on or near all lease tracts. Winter concentration areas occur on or near lease tracts in the Slick Rock area (10, 11, 11A, 12, 13, 13A, 14, 15, 15A, 16, and 16A).

TABLE 3.6-21 (Cont.)

Common Name	Scientific Name	Status[a]	Habitat and Occurrence in the ULP Project Area[c]
Mammals (Cont.)			
Northern river otter	*Lutra canadensis*	CO-T	Occupies riparian and riverine habitats where permanent water is available. Feeds primarily on fish and crustaceans. Known to occur in the Dolores River, which flows through portions of Lease Tracts 13A, 13, and 14.
Spotted bat	*Euderma maculatum*	BLM-S; FS-S	Occurs near forests and shrubland habitats. Uses caves and rock crevices for day roosting and winter hibernation. Known to occur at Lease Tract 27. According to the SWReGAP habitat model, potentially suitable year-round habitat could occur on or near all lease tracts.
Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM-S; FS-S	Inhabits semiarid shrublands, piñon-juniper woodlands, and montane forests below elevations of 10,000 ft. Roosts in caves, mines, rock crevices, under bridges, or within buildings. Quad-level occurrences for this species intersect Lease Tracts 10, 11, 12, 16, 16A, 19, 19A, 20, 24, 26, and 27. Known to occur at Lease Tracts 8, 12, 13, 13A, 14, 15, 16, 23, 26, and 27. According to the SWReGAP habitat model, potentially suitable year-round habitat for this species could occur on or near all lease tracts.
White-tailed prairie dog	*Cynomys leucurus*	BLM-S; FS-S	In Colorado, this species is known from the northwestern and west-central portion of the state. Inhabits open shrublands, semidesert grasslands, and mountain valleys. Not known to occur near any of the lease tracts. According to the SWReGAP habitat model, however, potentially suitable year-round habitat could occur on or near the Gateway and Uravan lease tracts (18, 19, 19A, 24, 25, 26, and 27).

[a] BLM-S = listed as sensitive by the BLM; CO-E = listed as endangered by the state of Colorado; CO-T = listed as threatened by the state of Colorado; ESA-C = candidate for listing under the ESA; ESA-E = listed as endangered under the ESA; ESA-T = listed as threatened under the ESA; ESA-XN = experimental, nonessential population under the ESA; FS-S = listed as sensitive by the USFS.

[b] The potential to occur on or near ULP lease tracts is based on the known or potential distribution and availability of suitable habitat in the vicinity of the ULP lease tracts. Sources that were considered included USFWS (2011a,b), CNHP (2011a,b), CPW (2011a), CPW (2012a), and USGS (2007). If potential for occurrence exists, a site-specific survey will be conducted prior to any ground-disturbing activity.

[c] The availability of potentially suitable habitat was determined by using SWReGAP habitat suitability models (USGS 2007). Quad-level occurrences were obtained from CNHP (2011b). Habitat and natural history information was obtained from NatureServe (2011), CNHP (2011a), and CPW (2011a).

- *Candidate:* Species for which the USFWS has sufficient information on its biological status and threats that it could propose the species as threatened or endangered under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing actions.

- *Critical habitat:* Critical habitat for a listed species consists of

  – Specific areas within the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the ESA, on which are found those physical or biological features (constituent elements) (a) that are essential to the conservation of the species and (b) that may require special management considerations or protection; and
  – Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the ESA, upon a determination by the Secretary of the Interior that such areas are essential for the conservation of the species.

Designated critical habitats are described in 50 CFR Parts 17 and 226.

These 10 ESA-listed, proposed, and candidate species are listed in Table 3.6-22 and are further discussed below. For these species, programmatic consultation with the USFWS was required to comply with Section 7 of the ESA. The final consultation documents (Biological Assessment [BA] and Biological Opinion [BO]) are provided in Appendix E. Additional information on the status, ecology, and natural history of these species is also provided in the BA in Appendix E. Additional lease-specific consultation with the USFWS may be required prior to the approval of project development and subsequent ground-disturbing activities.

There are no plants or invertebrates listed under the ESA that could occur in the vicinity of the ULP lease tracts. The Federally threatened Colorado hookless cactus (*Sclerocactus glaucus*) may occur in Mesa and Montrose Counties; however, this species and its habitat do not occur near any of the ULP lease tracts (Holsinger 2012). The uncompagre fritillary butterfly (*Boloria acrocnema*) is a Federally endangered butterfly that is known to occur in alpine (above 12,000 ft [3,658 m]) habitats in San Miguel County. However, none of these habitats occur in the vicinity of any of the ULP lease tracts.

3.6.4.1.1 Fish. There are four ESA-listed species of fish that may have suitable habitat occurring on or near the ULP lease tracts: the bonytail chub; Colorado pikeminnow; humpback chub; and razorback sucker. Collectively, these fish species are referred to as the Colorado River endangered fishes. Each of these fish species historically inhabited tributaries of the Colorado River system, including portions of the Dolores and San Miguel Rivers in the ULP project counties. Current populations of the Colorado River endangered fishes no longer inhabit these rivers in the vicinity of the lease tracts. The last recorded observation of any of these species in the Dolores River was in 1991 when four Colorado pikeminnow were captured in the lower portion of the river (Valdez et al. 1992). Suitable habitat and populations may occur in the Colorado River downstream from the Dolores River, which is downgradient from several lease

TABLE 3.6-22 Species Listed, Proposed for Listing, or Candidates for Listing under the ESA That May Occur in the Vicinity of the ULP Lease Tracts

Common Name	Scientific Name	ESA Status	Potential ULP County Occurrence	Designated Critical Habitat (Y/N)	ULP Counties in Which Critical Habitat Occurs	Recovery Plan (Y/N)
Fish						
Bonytail chub	*Gila elegans*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Colorado pikeminnow	*Ptychocheilus lucius*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Humpback chub	*Gila cypha*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Razorback sucker	*Xyrauchen texanus*	Endangered	Mesa, Montrose, San Miguel	Y	Mesa	Y
Birds						
Gunnison sage-grouse	*Centrocercus minimus*	Proposed Endangered	Mesa, Montrose, San Miguel	N[a]	NA	N
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Montrose, San Miguel	Y	NA	Y
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Mesa, Montrose, San Miguel	Y	NA	Y
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	Candidate	Mesa, Montrose, San Miguel	N	NA	N
Mammals[b]						
Black-footed ferret	*Mustela nigripes*	Endangered	Mesa, Montrose, San Miguel	N	NA	Y
Gunnison's prairie dog	*Cynomys gunnisoni*	Candidate	Montrose, San Miguel	N	NA	N

[a] Critical habitat for the Gunnison sage-grouse has been proposed (USFWS 2013a,b).

[b] The Canada lynx is a Federally threatened species, and the North American wolverine is a candidate for listing under the ESA. Both of these species have the potential to occur in the project counties. However, suitable habitat for these species is not likely to occur in the vicinity of the ULP lease tracts.

Source: USFWS (2011a)

tracts and flows through Lease Tracts 13, 13A, and 14 (Table 3.6-21). The confluence of the Colorado River and the Dolores River is in northeastern Utah, approximately 35 river miles (56 km) downstream from the nearest ULP lease tract (26). The confluence between the Colorado River and the Dolores River is approximately 56 river miles (90 km) downstream from the confluence of the Dolores and San Miguel Rivers (Figure 3.6-14). Designated critical habitat for the Colorado River endangered fishes also occurs in the Colorado River in Mesa County, downstream from the Dolores River (Table 3.6-22). The location of the ULP lease tracts relative to designated critical habitat for the Colorado River endangered fishes is shown in Figure 3.6-14.

The bonytail chub was listed as an endangered species under the ESA on April 23, 1980. Critical habitat for this species was designated within 310 mi (500 km) of the Colorado River basin on March 21, 1994. Designated critical habitat spans five states and includes portions of the Colorado, Green, and Yampa Rivers in the Upper Basin of the Colorado River. Currently, there are no self-sustaining populations of bonytail chub in the wild; only a small number of adults exist in the wild in the Green River and upper Colorado River. Hatchery-reared adults have been released into these rivers, but results indicate a low survival rate and no reproduction or recruitment (USFWS 2002a).

The Colorado pikeminnow was listed as an endangered species under the ESA on March 11, 1967. Critical habitat for this species was designated within 1,100 mi (1,850 km) of the Colorado River basin on March 21, 1994. Designated critical habitat spans three states and includes portions of the Colorado, Green, Yampa, White, and San Juan Rivers in the Upper Basin of the Colorado River. Currently, three wild reproducing populations of Colorado pikeminnow occur in the Green River, San Juan River, and upper Colorado River subbasins (USFWS 2002b).

The humpback chub was listed as an endangered species under the ESA on March 11, 1967. Critical habitat for this species was designated within 380 mi (610 km) of the Colorado River basin on September 19, 1990. Designated critical habitat spans three states and includes portions of the Colorado, Green, and Yampa Rivers in the Upper Basin of the Colorado River. The humpback chub is presently restricted to remote white water canyons. It is known to occur in the upper Colorado River (USFWS 1990).

The razorback sucker was listed as an endangered species under the ESA on October 23, 1991. Critical habitat for this species was designated within 1,700 mi (2,800 km) of the Colorado River basin on March 21, 1994. The critical habitat spans six states and includes portions of the Colorado, Duchesne, Green, Gunnison, San Juan, White, and Yampa Rivers in the Upper Basin of the Colorado River. Currently, the razorback sucker inhabits only about 25% of its historic range in the upper Colorado River basin (USFWS 2002c). In the upper basin of the Colorado River, the species is found in small numbers in the Green River, upper Colorado River, and San Juan River.

3.6.4.1.2 Birds. There are four ESA-listed or candidate species of birds that could occur on the ULP lease tracts or may have suitable habitat occurring on or near the ULP lease tracts:

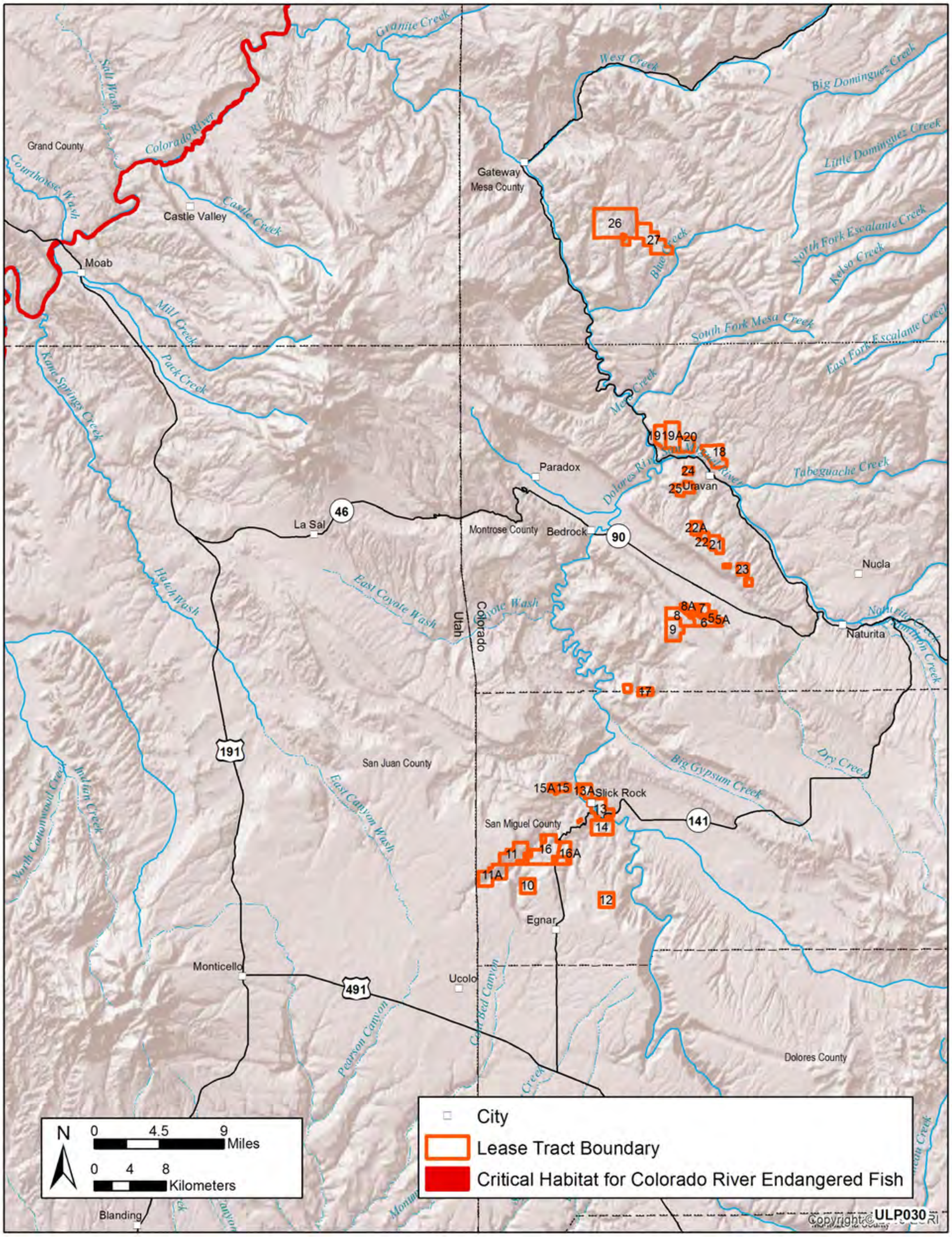


FIGURE 3.6-14 Locations of Designated Critical Habitat for the Colorado River Endangered Fishes in the Vicinity of the ULP Lease Tracts (USFWS 2011b)

the Gunnison sage-grouse; Mexican spotted owl; southwestern willow flycatcher; and western yellow-billed cuckoo (Table 3.6-22). These species are discussed individually here.

The Gunnison sage-grouse is a species proposed for listing as endangered under the ESA (USFWS 2013a). This species occurs in sagebrush-dominated habitats in southwestern Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah. This species is known to occur in Mesa, Montrose, and San Miguel Counties. Critical habitat for this species has been proposed in portions of western Colorado and eastern Utah (USFWS 2013b; Figure 3.6-15). The proposed critical habitat has been categorized as occupied, potential, or vacant/unknown critical habitat[18]. Although the species is not known to occur on any of the ULP lease tracts, a portion of the potential proposed critical habitat intersects several lease tracts in the Slick Rock area (Lease Tracts 10, 11, 11A, 12, 15A, 16, and 16A). No occupied or vacant/unknown proposed critical habitat intersects any of the ULP lease tracts. Occupied proposed critical habitat occurs within 1 mi (1.6 km) south of lease tracts in the Paradox area (Lease Tracts 6, 8, and 9) (Table 3.6-21; Figure 3.6-15).

The Mexican spotted owl was listed as a threatened species under the ESA on March 16, 1993. Critical habitat for this species was designated by the USFWS on June 6, 1995 (revised on February 1, 2001, and August 31, 2004). However, critical habitat for this species does not occur in the vicinity of any of the lease tracts. The Mexican spotted owl is known to occur in Montrose and San Miguel Counties, where it is considered to be a rare transient. However, recent surveys by the BLM and USFWS in these counties have not detected this species. The Mexican spotted owl inhabits steep canyons with dense old-growth coniferous forests. It is not known to occur on any of the lease tracts, but, according to the CNHP (2011b), quad-level occurrences for this species intersect Lease Tract 12 in southern San Miguel County. Suitable old growth forests and canyonlands do not occur on any of the lease tracts. According to the SWReGAP habitat suitability model, potentially suitable nonbreeding migratory habitat intersects and occurs in the vicinity of all lease tracts (Table 3.6-21; Figure 3.6-16).

The southwestern willow flycatcher was listed as an endangered species under the ESA on March 29, 1995. Critical habitat for this species was designated by the USFWS on July 22, 1997 (revised on October 19, 2005). However, critical habitat for this species does not occur in the vicinity of any of the lease tracts. The southwestern willow flycatcher is known to occur in San Miguel County, where it is an uncommon summer breeding resident. It nests in thickets, scrubby and brushy areas, open second growth, and riparian woodlands. This species is not known to occur in the vicinity of any of the lease tracts; however, according to the SWReGAP habitat suitability model for the species, potentially suitable summer nesting habitat may occur along the Dolores and San Miguel Rivers as well as their tributaries in Mesa, Montrose, and San Miguel Counties. These potentially suitable habitat areas occur downslope from and in the

[18] From USFWS 2013b, occupied proposed critical habitat refers to the geographic area occupied by the species at the time of the proposed listing. Potential proposed critical habitat is defined as “unoccupied habitats that could be suitable for occupation of sage grouse if practical restoration were applied.” The vacant/unknown potential critical habitat category is defined as “suitable habitat for sage grouse that is separated (not contiguous) from occupied habitats that either (1) has not been adequately inventoried, or (2) has not had documentation of grouse presence in the past 10 years.”

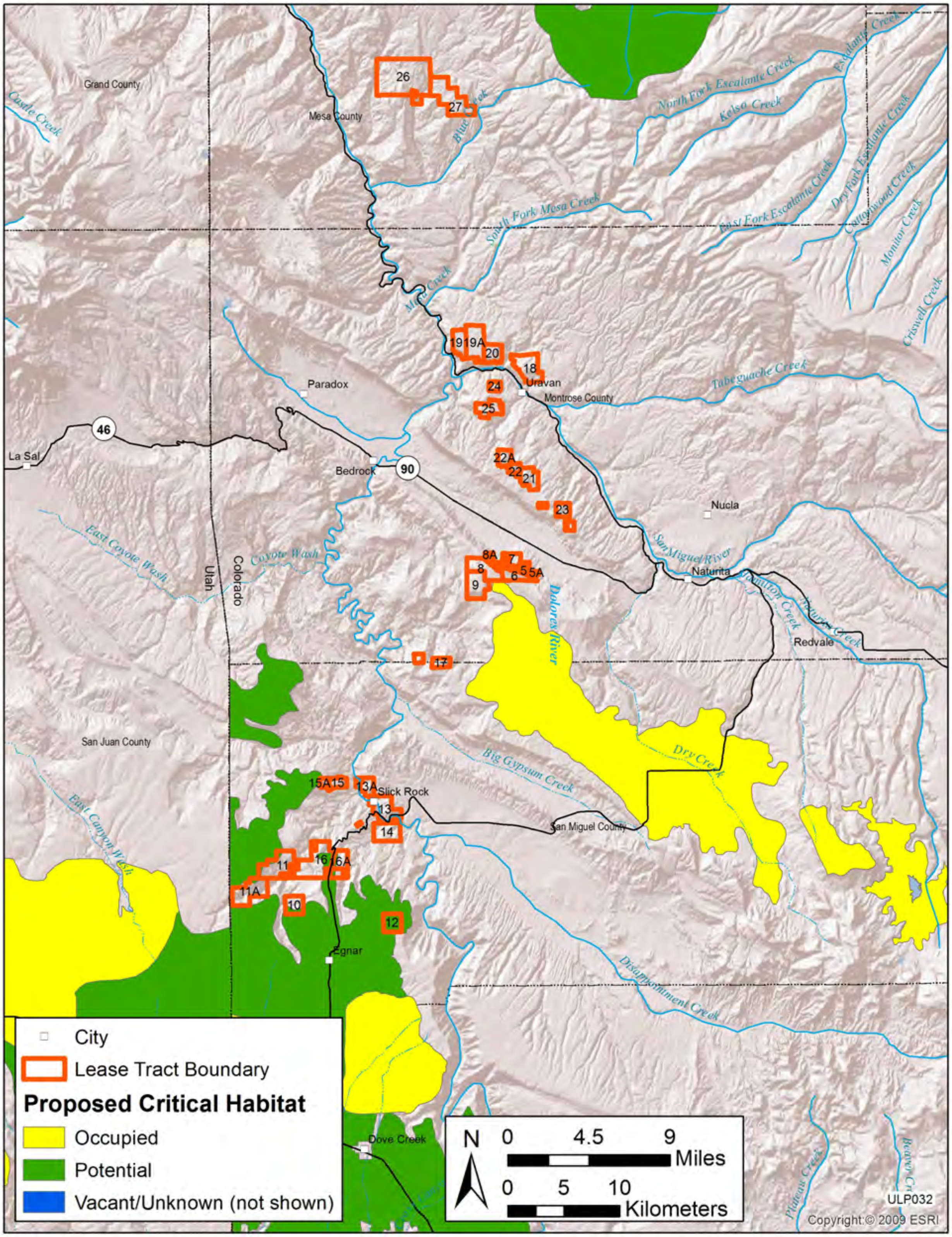


FIGURE 3.6-15 Distribution of Proposed Critical Habitat for the Gunnison Sage-Grouse in the Vicinity of the ULP Lease Tracts (USFWS 2013b)

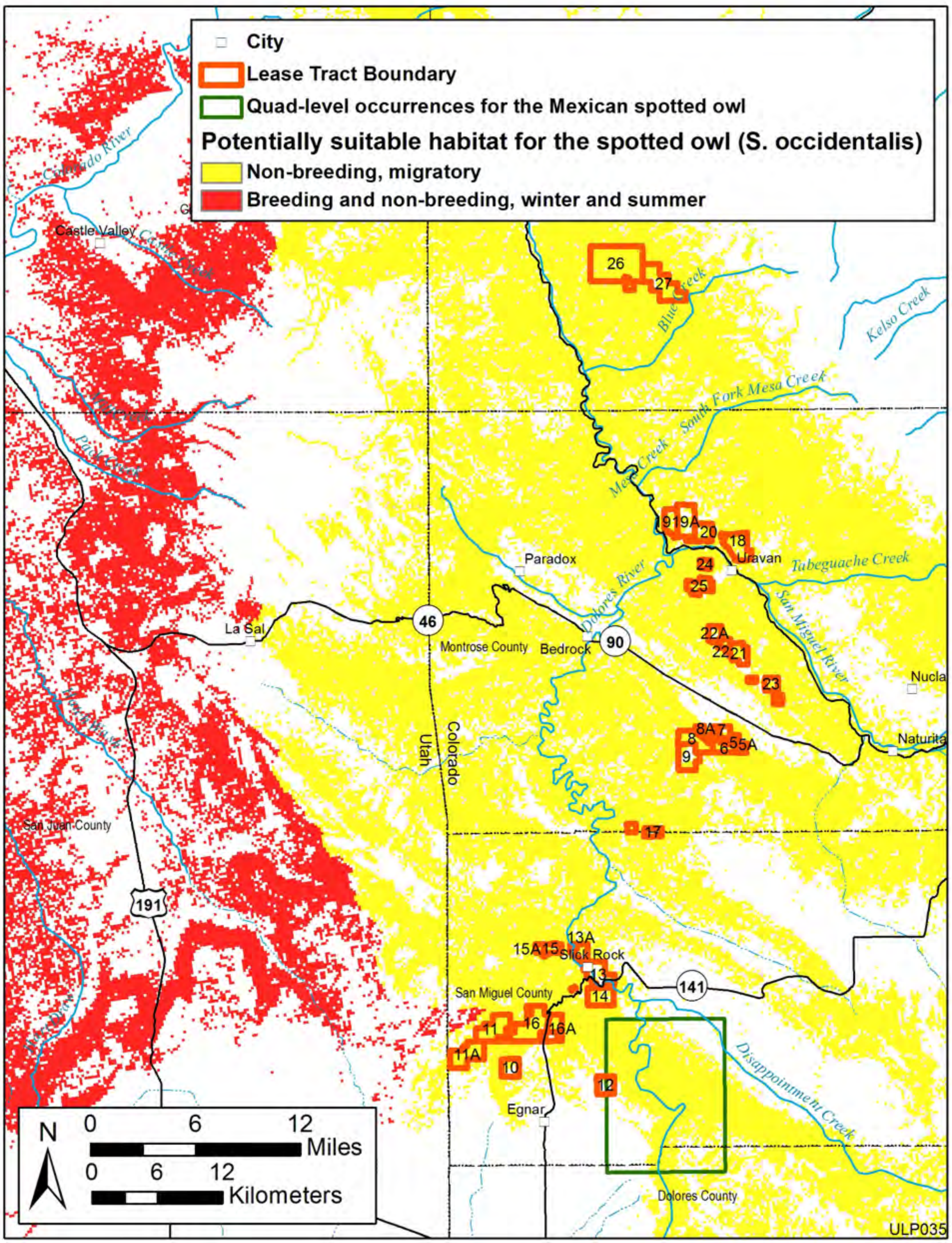


FIGURE 3.6-16 Recorded Occurrences and Distribution of Potentially Suitable Habitat for the Mexican Spotted Owl in the Vicinity of the ULP Lease Tracts (CNHP 2011b; USGS 2007)

vicinity of all lease tracts; they also intersect lease tracts in the Slick Rock area (13, 13A, and 14) along the Dolores River (Table 3.6-21; Figure 3.6-17).

The western yellow-billed cuckoo is considered by the USFWS as a "distinct population segment" (DPS) (subspecies *occidentalis*) of the yellow-billed cuckoo. This species became a candidate for listing under the ESA on October 30, 2001. It inhabits deciduous riparian woodlands, particularly cottonwood and willow. The western yellow-billed cuckoo is known to occur in Mesa and Montrose Counties, where it is an uncommon summer breeding resident. This species is not known to occur in the vicinity of any of the lease tracts; however, according to the SWReGAP habitat suitability model for the species, potentially suitable summer nesting habitat may occur along the Dolores River in southern Mesa and northern Montrose Counties. These potentially suitable habitat areas do not intersect any of the lease tracts, but they do occur downslope from and in the vicinity of Calamity Mesa, Outlaw Mesa, and Uravan lease tracts (Table 3.6-21; Figure 3.6-18).

3.6.4.1.3 Mammals. There are two ESA-listed or candidate species of mammals that could occur on the ULP lease tracts or may have suitable habitat occurring on or near the ULP lease tracts: the black-footed ferret and the Gunnison's prairie dog (Table 3.6-21). Suitable habitat for the Canada lynx may occur in the three project counties. However, given the strict habitat requirements for this species (high-elevation coniferous forests), suitable habitat for this species is not expected to occur near any of the ULP lease tracts (Figure 3.6-18).

The black-footed ferret was listed as an endangered species under the ESA on March 11, 1967. It is the only ferret species native to North America. Black-footed ferrets historically occurred in western Colorado, but it is believed it has been extirpated from the state since the 1950s. Experimental, nonessential populations have been established in the northwestern portion of Colorado as well as elsewhere throughout its historic range. This species inhabits prairies and semiarid shrublands where it preys upon prairie dogs. Black-footed ferrets are not known to occur in the vicinity of any of the lease tracts, and the SWReGAP model for the species indicates that no suitable habitat for the species occurs in the vicinity of the lease tracts. However, the species may occur on or near some of the lease tracts that support prairie dog towns (Table 3.6-21). The lease tracts have not been surveyed for prairie dog towns that might meet criteria for ferret habitat. Critical habitat for this species has not been designated.

The Gunnison's prairie dog became a candidate for listing under the ESA on February 5, 2008. It inhabits mountain valleys, plateaus, and open brush habitats at elevations between 6,000 and 12,000 ft (1,800 and 3,700 m). This species is known to occur in Montrose and Mesa Counties as a year-round resident and to occur in at least one ULP lease tract. According to information provided by CPW, the overall range for the Gunnison's prairie dog intersects several Paradox and Uravan lease tracts (Table 3.6-21; Figure 3.6-19).

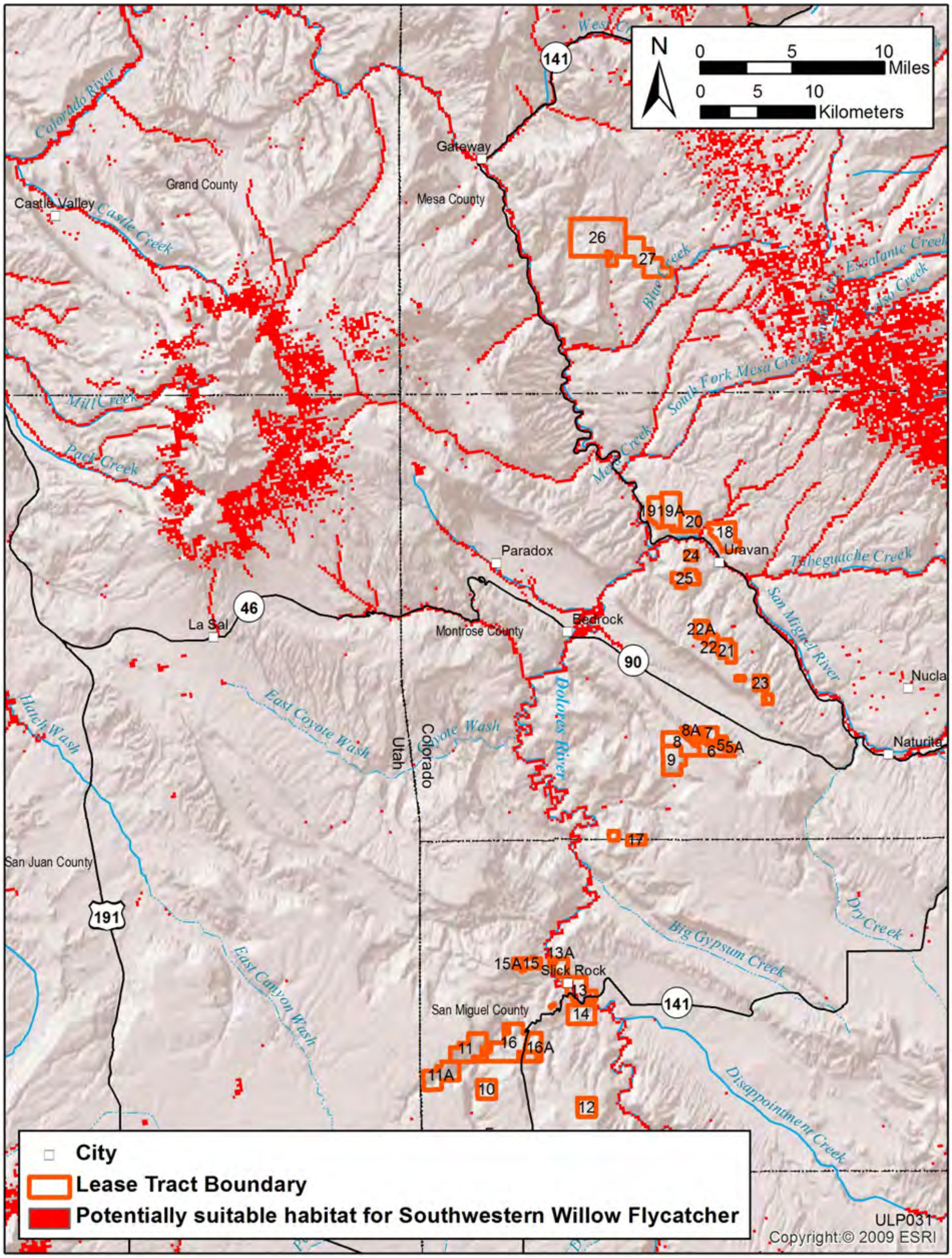


FIGURE 3.6-17 Distribution of Potentially Suitable Habitat for the Southwestern Willow Flycatcher in the Vicinity of the ULP Lease Tracts (USGS 2007)

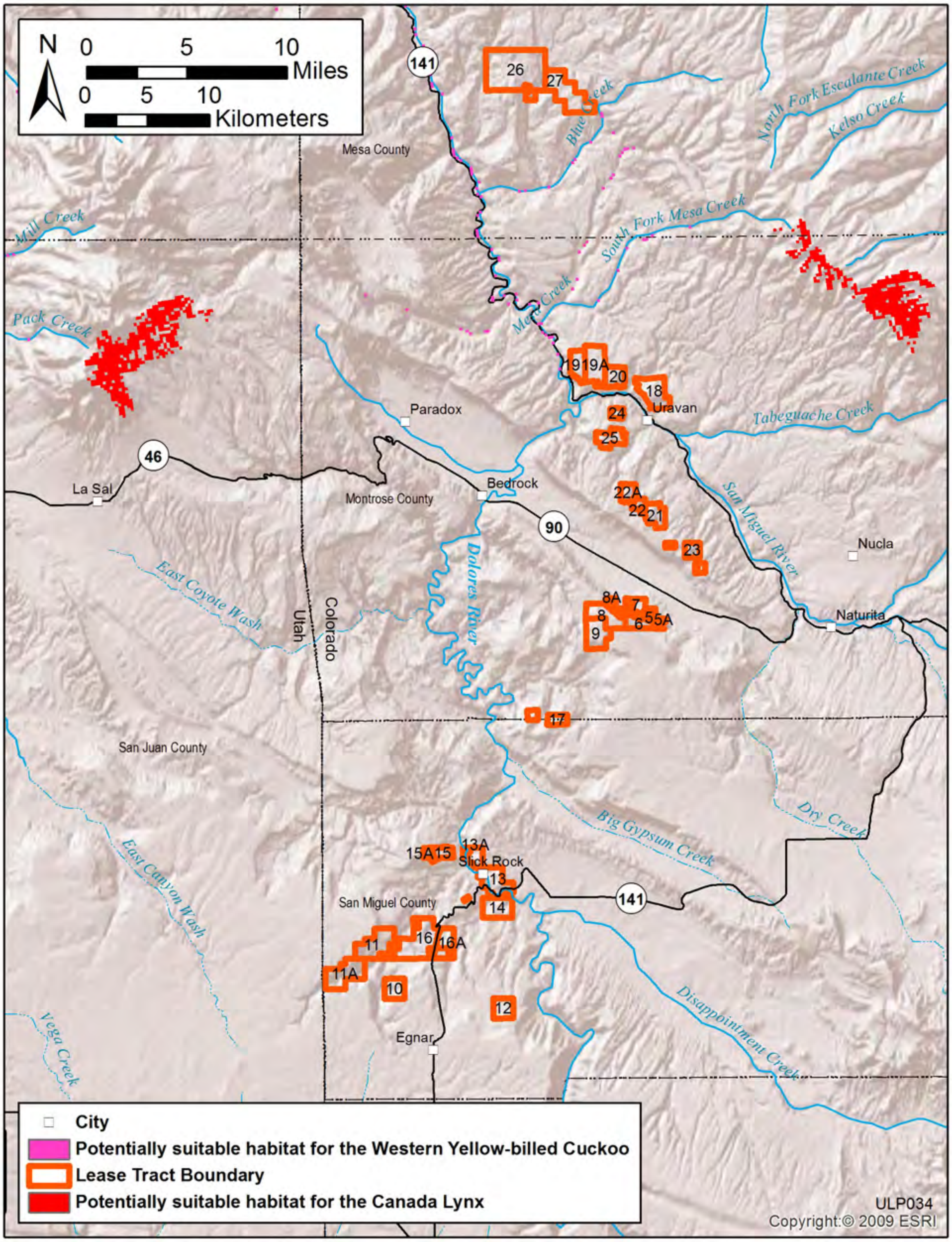
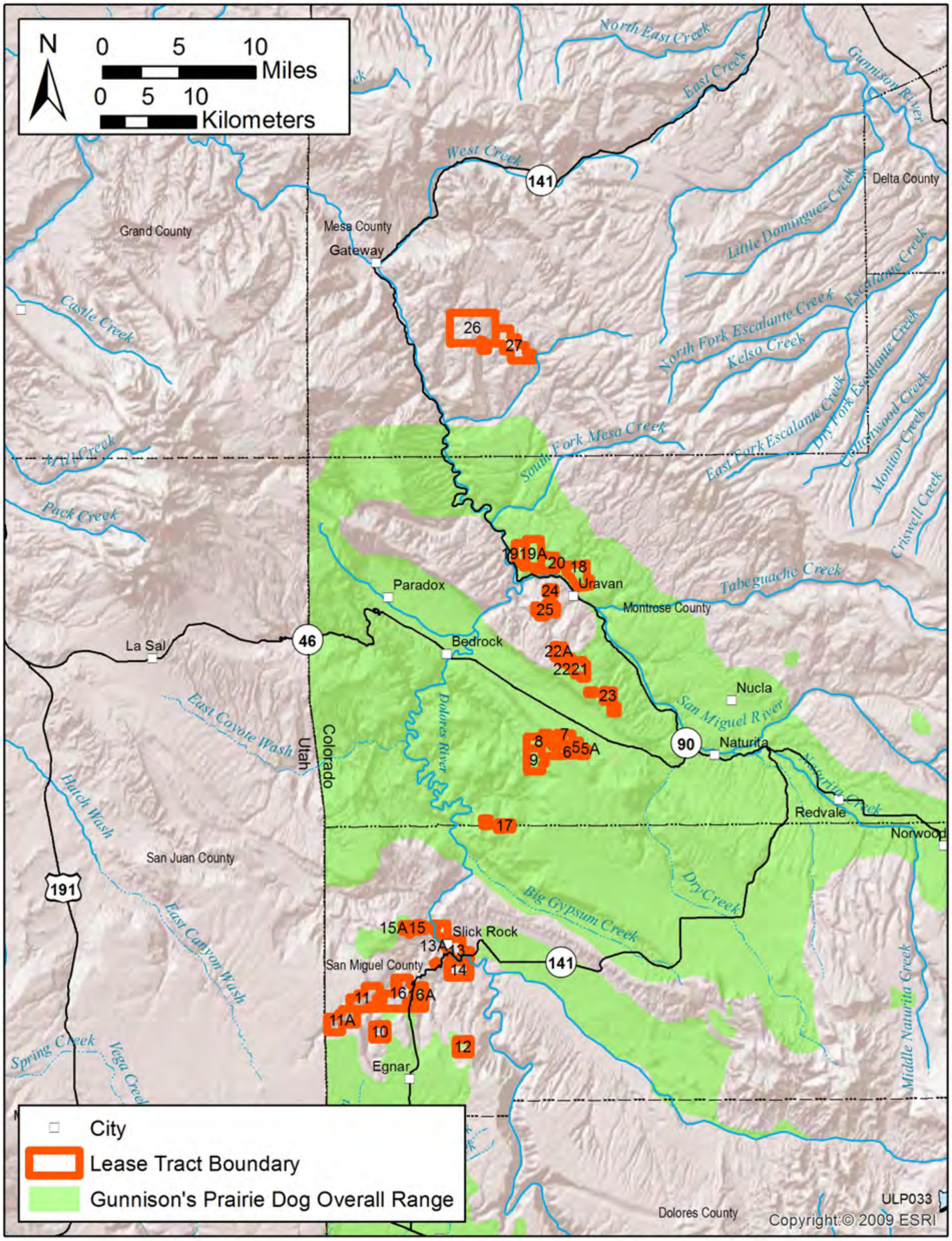


FIGURE 3.6-18 Distribution of Potentially Suitable Habitat for the Western Yellow-Billed Cuckoo and Canada Lynx in the Vicinity of the ULP Lease Tracts (USGS 2007)



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2 **FIGURE 3.6-19 Distribution of Potentially Suitable Habitat for the Gunnison's Prairie Dog in**
3 **the Vicinity of the ULP Lease Tracts (USGS 2007)**

3.6.4.2 Sensitive and State-Listed Species

In addition to species listed under the ESA, several sensitive species may occur in the vicinity of the ULP lease tracts. For this assessment, these species include those that are designated as sensitive by the BLM and USFS, as well as those listed as threatened or endangered by the State of Colorado.

The BLM has established a policy, as specified in BLM Manual 6840, *Special Status Species Management* (BLM 2008a), that is designed "to provide policy and guidance for the conservation of BLM special status species and the ecosystems upon which they depend on BLM-administered lands." BLM special status species are identified in that manual as "(1) species listed or proposed for listing under the ESA, and (2) species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the ESA, which are designated as Bureau sensitive by the State Director(s). All Federal candidate species, proposed species, and delisted species in the 5 years following delisting will be conserved as Bureau sensitive species." In addition, each BLM state director maintains a list of sensitive species, and impacts on these species would have to be considered in project-specific assessments developed before any activity that would affect them or their critical habitat could be approved.

The USFS has identified species considered sensitive under USFS Manual 2670 (USFS 2005). Many of these species are also listed as sensitive by the BLM.

The State of Colorado has also identified species that are threatened or endangered with extinction from the state under the Colorado Revised Statute 33-2-101. Many state-listed species are also listed as BLM sensitive species or USFS sensitive species, and some are also listed under the ESA. In cooperation with the USFWS, states are required to monitor, for no less than 5 years, the status of all species that have recovered to a point at which they are no longer listed as threatened or endangered (e.g., bald eagle).

By definition, all the species listed in Table 3.6-21 are considered to be sensitive species, including the 10 species listed or candidates for listing under the ESA (Section 3.6.4.1). Of the sensitive species that may occur on or near the ULP lease tracts, 41 are designated as sensitive by the BLM, 20 are designated as sensitive by the USFS, and 10 are listed as threatened or endangered by the State of Colorado. A summary of sensitive species by taxonomic group is provided in Table 3.6-23. Many of these species are protected under one or more regulatory statute (e.g., Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act), and some are listed under the ESA. A discussion of these species by listing status is provided below.

3.6.4.2.1 BLM Sensitive Species. A total of 41 species are designated as sensitive by the Colorado BLM state office that have the potential to occur on or in the vicinity of the ULP lease tracts. The ecology, habitat requirements, and potential distribution of each of these species in the vicinity of the ULP lease tracts are provided in Table 3.6-21. Of these BLM-designated sensitive species, there are 16 plants, 1 invertebrate, 3 fish, 3 amphibians, 2 reptiles, 9 birds, and

TABLE 3.6-23 Number of Sensitive Species That May Occur on or near ULP Lease Tracts

Taxonomic Group	Number of Sensitive Species[a]
Plants	17
Insects	1
Fish	7
Amphibians	4
Reptiles	2
Birds	12
Mammals	8

[a] Sensitive species are those that have been designated as sensitive by the BLM or USFS, as well as those species listed as threatened or endangered by the State of Colorado under *Colorado Revised Statutes* 33-2-101. Note: Sensitive species may also be listed under the ESA.

7 mammals. Some of the BLM-designated sensitive species are previously listed or considered for listing under the ESA.

Most of the BLM-designated sensitive plant species have the potential to inhabit desert shrublands or piñon-juniper forests in one or more of the ULP counties (Mesa, Montrose, or San Miguel). Shrublands and piñon-juniper forests either dominate or have the potential to occur on every ULP lease tract. These BLM-designated sensitive plant species also occur at elevation ranges that generally coincide with the elevation ranges for one or more of the ULP lease tracts.

The single BLM-designated sensitive invertebrate species –the Great Basin silverspot butterfly (*Speyeria nokomis nokomis*)—inhabits streamside meadows and other riparian areas in western Colorado. It is not known to occur in the vicinity of the ULP lease tracts, but suitable habitat could occur on each of the lease tracts in each of the ULP counties.

The three BLM-designated sensitive fish species (bluehead sucker, flannelmouth sucker, and roundtail chub) could occur in the project area in the Dolores and San Miguel Rivers. The Dolores River intersects Lease Tracts 13A, 13, and 14. Suitable habitat may also occur downgradient and in the vicinity of several other lease tracts. All three species are experiencing variable or declining population trends in the Dolores River. Two of these species (bluehead sucker and roundtail chub) may be extirpated from upstream reaches near McPhee Reservoir (Bestgen et al. 2011).

The three BLM-designated sensitive amphibian species are generally associated with montane riparian areas that occur in one or more of the project counties. These species also occur at elevation ranges that generally coincide with the elevation ranges for one or more of the ULP lease tracts. According to the SWReGAP habitat suitability models, suitable habitat for these species could occur on or in the vicinity of several lease tracts.

The two BLM-designated sensitive reptile species are generally associated with montane shrublands and slopes. Quad-level occurrences for both of these species intersect at least one ULP lease tract. According to the SWReGAP habitat suitability models, suitable habitat for these species could occur on or in the vicinity of several lease tracts.

Several BLM-designated sensitive bird species could occur in the ULP project area. These species occur as summer breeding residents, winter residents (including transients and migrants), or year-round residents. According to records provided by the CNHP and SWReGAP habitat suitability models, these species are either known to occur or may have suitable habitat in one or more of the ULP lease tracts. The summer breeding residents include species such as Brewer's sparrow (*Spizella breweri*) and peregrine falcon (*Falco peregrinus*). Nesting habitat for these species may occur on or in the vicinity of several lease tracts (Table 3.6-21). Winter residents include species such as the bald eagle (*Haliaeetus leucocephalus*), ferruginous hawk (*Buteo regalis*), and northern goshawk (*Accipiter gentilis*). Some of these species are known to occur in the vicinity of several lease tracts. According to the SWReGAP habitat suitability models, potentially suitable winter foraging habitat for these species may occur on or in the vicinity of several lease tracts. Year-round permanent residents in the ULP project area include species such as the burrowing owl (*Athene cunicularia*). This species inhabits grasslands and shrublands, preying upon prairie dogs and inhabiting their burrows. Occurrences and potentially suitable habitat for this species are known from the vicinity of several lease tracts.

Most of the BLM-designated sensitive mammal species are bat species. There are four bat species that are BLM-designated sensitive that could occur on or in the vicinity of the ULP lease tracts. Some of these bat species have been documented to occur in the vicinity of the ULP lease tracts (e.g., fringed myotis [*Myotis thysanodes*]). Bat species in the project area may forage in riparian areas, shrublands, and piñon-juniper woodlands. One or more of these habitat types could occur on each of the ULP lease tracts. Bats in the region roost in rock crevices, caves, mines, and trees. These potential roost sites also occur on or in the vicinity of each of the ULP lease tracts. According to records provided by Colorado Parks and Wildlife, various species of bats (including sensitive species) have been documented to roost in the mines on Lease Tracts 8, 12, 13, 13A, 14, 15, 16, 23, 26, and 27 (CPW 2012a). For all these bat species, SWReGAP habitat suitability models indicate the presence of potentially suitable habitat in the vicinity of one or more lease tracts (Table 3.6-21).

Other BLM-designated sensitive mammal species that could occur in the project area include desert bighorn sheep (*Ovis canadensis nelsoni*) and white-tailed prairie dog (*Cynomys leucurus*). According to SWReGAP habitat suitability models, potentially suitable habitat for each of these species may occur on or in the vicinity of several lease tracts. According to information provided by CPW (2012b), desert bighorn sheep are known to occur in 5 lease tracts

(Lease Tracts 9, 13, 13A, 14, and 15); they may also occur in winter concentration areas near 11 lease tracts (Lease Tracts 10, 11, 11A, 12, 13, 13A, 14, 15, 15A, 16, and 16A).

3.6.4.2.2 USFS Service Sensitive Species. A total of 20 species designated as sensitive by the USFS that have the potential to occur on or in the vicinity of the ULP lease tracts. The ecology, habitat requirements, and potential distribution of each of these species in the vicinity of the ULP lease tracts are provided in Table 3.6-21. Of these sensitive species, there are two plants, three fish, one amphibian, eight birds, and six mammals. Most of the USFS sensitive species are previously listed or considered for listing under the ESA or are BLM-designated sensitive species. The only UFSF-designated sensitive species that are not previously discussed include Wetherill's milkvetch (*Astragalus wetherillii*) and sage sparrow (*Amphisppiza belli*). The Wetherill's milkvetch inhabits slopes and cliffs and is known to occur in the vicinity of lease tracts 5, 5A, 6, and 7. The sage sparrow is a summer breeding resident that nests in sagebrush shrublands. Potentially suitable habitat for this species could occur on or near all lease tracts.

3.6.4.2.3 State-Listed Species. A total of 10 species listed as threatened or endangered by the State of Colorado have the potential to occur on or in the vicinity of the ULP lease tracts. The ecology, habitat requirements, and potential distribution of each of these species in the vicinity of the ULP lease tracts are provided in Table 3.6-21. Of these species, there are four fish, one amphibian, three birds, and two mammals. Most of these species are previously listed or considered for listing under the ESA, or are BLM- or USFS-designated sensitive species. The only state-listed species not previously discussed are the boreal toad (*Bufo boreas*) and northern river otter (*Lutra canadensis*). The boreal toad typically inhabits montane riparian and aquatic habitats at elevations between 8,500 and 11,500 ft (2,570 and 3,500 m). Although suitable habitat for this species is not likely to occur on any of the lease tracts, potentially suitable habitat may occur in the vicinity of lease tracts 19, 26, and 27. The northern river otter inhabits riverine systems where permanent water is present. It is known to occur in the Dolores River, which flows through Lease Tracts 13, 13A, and 14.

3.7 LAND USE

The ULP lease tracts are located on public land administered by the BLM. The BLM manages its lands within a framework of numerous laws, the most comprehensive of which is the FLPMA. The FLPMA established the "multiple use" management framework for public lands so that "public lands and their various resource values … are utilized in the combination that will best meet the present and future needs of the American people" (from Section 103(a) of FLPMA). The FLPMA ensures that no predominant or single use overrides the multiple-use concept of any of the lands managed by the BLM. BLM-administered lands (and resources) are used for domestic livestock grazing; fish and wildlife development and utilization; mineral exploration, development and production; ROWs; outdoor recreation; and timber production.

Beginning in 1948, lands within the Uravan Mineral Belt in southwestern Colorado (including the subject 31 lease tracts) were withdrawn from mineral entry under Public Land

Order 459 (and others) to reserve them for the exploration and development of uranium and vanadium resources. These lands are currently managed under the ULP. Under the ULP, DOE maintains jurisdiction and authority over all mining-related activities on the lease tracts (exploration, development, mining, and transportation); the BLM maintains jurisdiction over all other surface uses. During the term of the land withdrawal, the lands cannot be appropriated, sold, or exchanged, and new mining claims cannot be filed. However, the lands remain open to mineral leasing (e.g., oil and gas) and the mineral material laws. They also remain open to ROW authorizations (for pipelines, transmission lines, and roads).

3.7.1 Specially Designated Areas and Lands with Wilderness Characteristics

Most of the lands surrounding the lease tracts are administered by the BLM (Figure 3.7-1). Some of these lands are components of the BLM's National Landscape Conservation System (NLCS), which includes more than 886 Federally recognized areas and about 27 million acres (11 million ha) of specially designated areas, mainly in the western United States. The purpose of the NLCS is to "conserve, protect, and restore nationally significant landscapes with outstanding cultural, ecological, and scientific values for the benefit of current and future generations" (BLM 2011g). Specially designated areas are those areas designated by an E.O., by an Act of Congress, or by the BLM through its land use planning process, as being deemed to possess unique or important resource values. Examples include ACECs, SRMAs, and WSAs. Table 3.7-1 lists the types of specially designated areas and their acreages (or mileage) within 25 mi (40 km) of the lease tracts; lands managed by the USFS are also listed.

The BLM also has inventories of Lands with Wilderness Characteristics (LWCs) within 25 mi (40 km) of the ULP lease tracts. These lands are defined by BLM as (1) being of sufficient size (generally more than 5,000 acres [2,000 ha] of roadless, contiguous BLM lands, excluding State or private lands), (2) being natural, (3) having outstanding opportunities for solitude or primitive and unconfined recreation, and (4) having supplemental values, such as ecological, geological, or other features of scientific, educational, scenic, or historical value (BLM 2012d,e). Table 3.7-2 lists and describes the LWCs near the ULP lease tracts; Figure 3.7-2 shows their locations.

Several river segments within the region have been determined by BLM to be eligible for inclusion in the National Wild and Scenic Rivers (WSR) System (Figure 3.7-3). WSR designation preserves and protects the free-flowing condition, water quality, and outstanding remarkable values (ORVs) of selected rivers or river segments and provides legal protections from development. Table 3.7-3 lists the river segments eligible for WSR designation within 25 mi (40 km) of the lease tracts based on BLM's WSR eligibility reports for the Uncompahgre, Grand Junction, and Tres Rios Field Office or Planning Area (BLM 2010e, 2009d; USFS and BLM 2013). These include several segments and tributaries of the San Miguel and Dolores Rivers.

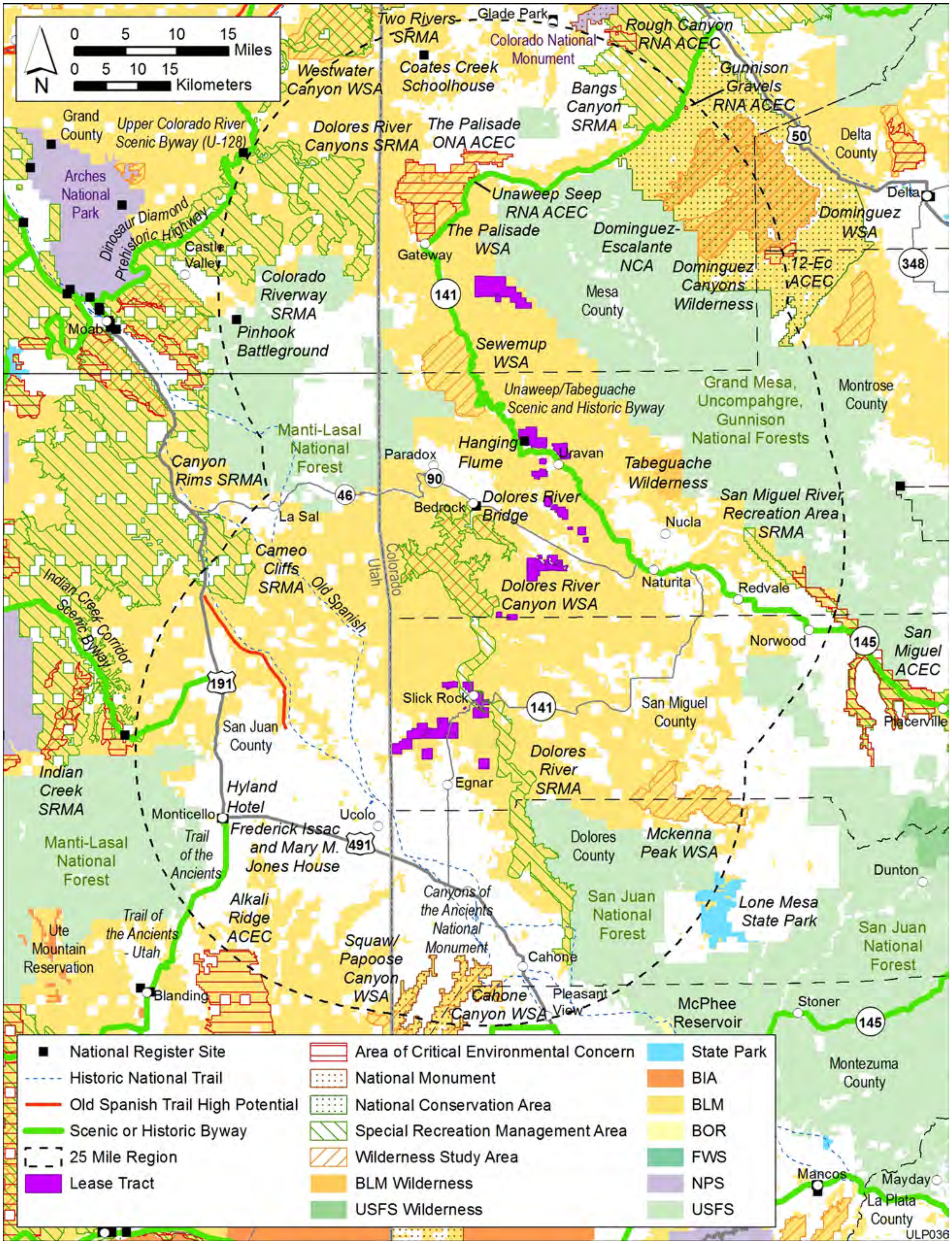

FIGURE 3.7-1 Specially Designated Areas on Public Lands near the ULP Lease Tracts

TABLE 3.7-1 Specially Designated Areas on Public Lands within 25 mi (40 km) of the ULP Lease Tracts

Name	Acreage
Areas of Critical Environmental Concern	
12-Ec	1,441
Alkali Ridge	1,713
Gunnison Gravels RNA[a]	40
Rough Canyon RNA	79
San Miguel	2,959
The Palisade ONA[a]	23,648
Unaweep Seep RNA	78
BLM Wilderness Areas	
Dominguez Canyons Wilderness Area	37,530
Tabeguache Wilderness	8,1860
Colorado State Park	
Lone Mesa State Park	1,689
National Monument	
Canyons of the Ancients	15,944
National Park Service Land	
Colorado National Monument	14
National Register of Historic Places *Sites*	
Coates Creek Schoolhouse	1
Dolores River Bridge	1
Frederick Isaac and Mary M. Jones House	1
Hanging Flume	4
Hyland Hotel	1
Pinhook Battleground	8
Special Recreation Management Areas	
Bangs Canyon	23,579
Cameo Cliffs	9,941
Canyon Rims	274
Colorado Riverway	30,056
San Miguel River	TBP
Dolores River	65,270
Dolores River Canyon	31,670
Indian Creek	566
Two Rivers	3,788
U.S. Forest Service Lands	
Grand Mesa, Uncompahgre, and Gunnison National Forests	411,767
Manti-Lasal National Forest	176,752
San Juan National Forest	121,532
Wilderness Study Areas	
Cahone Canyon	9,153
Dolores River Canyon	29,166
Dominguez	39,903
McKenna Peak	19,337
Sewemup	19,637
Squaw/Papoose Canyon	2,460
The Palisade	26,656
Westwater Canyon	1,398

Name	Mileage
National Historic Trails	
High Potential Old Spanish Trail	17
Old Spanish Trail	173
Scenic Byways	
Dinosaur Diamond Prehistoric Highway (Colorado)	0.3
Dinosaur Diamond Prehistory Highway (Utah)	0.3
Indian Creek Corridor Scenic Byway	11
Trail of the Ancients (Colorado)	11
Trail of the Ancients (Utah)	
Unaweep/Tabeguache Scenic and Historic Byway	108
Upper Colorado River Scenic Byway (U-128)[b]	0.3

[a] RNA = Research Natural Area; ONA = Outstanding Natural Area.

[b] U = Utah.

TABLE 3.7-2 Lands with Wilderness Characteristics within 25 mi (40 km) of the ULP Lease Tracts

Name	Planning Area	Acreage	Description
Dolores River Canyon WSA Addition	Uncompahgre	3,750	Adjacent to the Dolores River Canyon WSA, with no recreation facilities. The unit does not possess outstanding opportunities for solitude; no supplemental values noted.
Roc Creek	Uncompahgre	7,650	Near but not contiguous with Sewemup Mesa WSA. Accessible only by foot or on horse; no recreational facilities.
Shavano Creek	Uncompahgre	6,090	Immediately north of the Tabeguache Area (separated by Montrose County Road V24 and therefore not adjacent).
CO-030-290-h	Tres Rios	3,115	Centered around the Coyote Wash drainage, west of the Dolores River WSA and east of the Utah/Colorado state line. Supplemental value noted for Mexican spotted owl habitat (endangered species).
CO-030-301-a	Tres Rios	10,150	Bounded on the west by private lands and spur roads near the canyon rim, Snaggletooth Road along the Dolores River on the east, and a county road on the south. Largely undeveloped, isolated canyon country. Supplemental value noted for very scenic river corridor.
CO-030-301-b	Tres Rios	19,510	Bounded on the north by Snaggletooth Road, on the west by Snaggletooth Road along the Dolores River, and on the east by roads and road spurs near the canyon rim. Largely undeveloped, isolated canyon country. Supplemental value noted for very scenic river corridor.
CO-030-286-b	Tres Rios	2,635	Bounded by wilderness inventory roads and the McKenna Peak WSA to the south and east. Supplemental value noted for wild horse herd.
CO-030-286-d	Tres Rios	2,390	Adjacent to McKenna Peak WSA. Supplemental value noted for Spring Creek wild horse herd.
CO-030-286-f	Tres Rios	1,578	Adjacent to McKenna Peak WSA. No supplemental values noted.
Bang’s Canyon (1)	Grand Junction	20,434	Located in Mesa County about 6 mi (10 km) south of Grand Junction. Supplemental value noted for critically sensitive cultural resources and ecology.

TABLE 3.7-2 (Cont.)

Name	Planning Area	Acreage	Description
Lumsden Canyon (18)	Grand Junction	10,072	Located in southern Mesa County, just west of the town of Gateway and Highway 141; encompasses a system of canyons which rise above the Dolores River. Unit offers geologic, scenic, and ecological supplemental values.
Maverick Canyon (20)	Grand Junction	20,401	Located in Mesa County, about 25 mi (40 km) southwest of Grand Junction. Bounded on the north by private lands and on the west by private lands and the Dolores River; east side of the unit follows the rims of various canyons. Supplemental value noted for the Juanita Arch, a natural bridge and the only one of its kind in Colorado.
Unaweep (30)	Grand Junction	7,154	Located in Mesa County, about 25 mi (40 km) southwest of Grand Junction and just northeast of Gateway. No supplemental values noted.
West Creek (31)	Grand Junction	111	Adjacent to existing Palisade WSA and the Palisade Outstanding Natural Area about 35 mi (56 km) southwest of Grand Junction. Supplemental value noted for unique hydrologic features and a rare species of butterfly.

Sources: BLM (2011o, 2012f,g)

3.7.2 Agriculture

According to the 2007 agriculture census (USDA 2009a), about 845,000 acres (3,400 ha) in Colorado counties within 25 mi (40 km) of the ULP lease tracts (Mesa, Montrose, and San Miguel) are classified as farmland[19] (Table 3.7-4). Most farmland in these counties (about 58%) is permanent pasture and rangeland, with the remainder classified as cropland (29%), woodland (8.3%), and land in farmsteads, buildings, and livestock facilities (4.6%). About 67% of cropland in these counties is irrigated. While there are far fewer farms in San Miguel County than in Mesa and Montrose Counties, the average farm size in San Miguel County is four to five times larger.

About 1.6 million acres (0.65 million ha) in Utah counties within 25 mi (40 km) of the ULP lease tracts (Grand and San Juan) are classified as farmland, with most of the farmland (about 97%) occurring in San Juan County (Table 3.7-4). Most of the farmland in these counties (about 87%) is permanent pasture and rangeland, with the remainder classified as cropland

[19] A farm is defined by the U.S. Department of Agriculture (USDA 2009a) as any place from which agricultural products worth $1,000 or more were produced or sold during the census year.

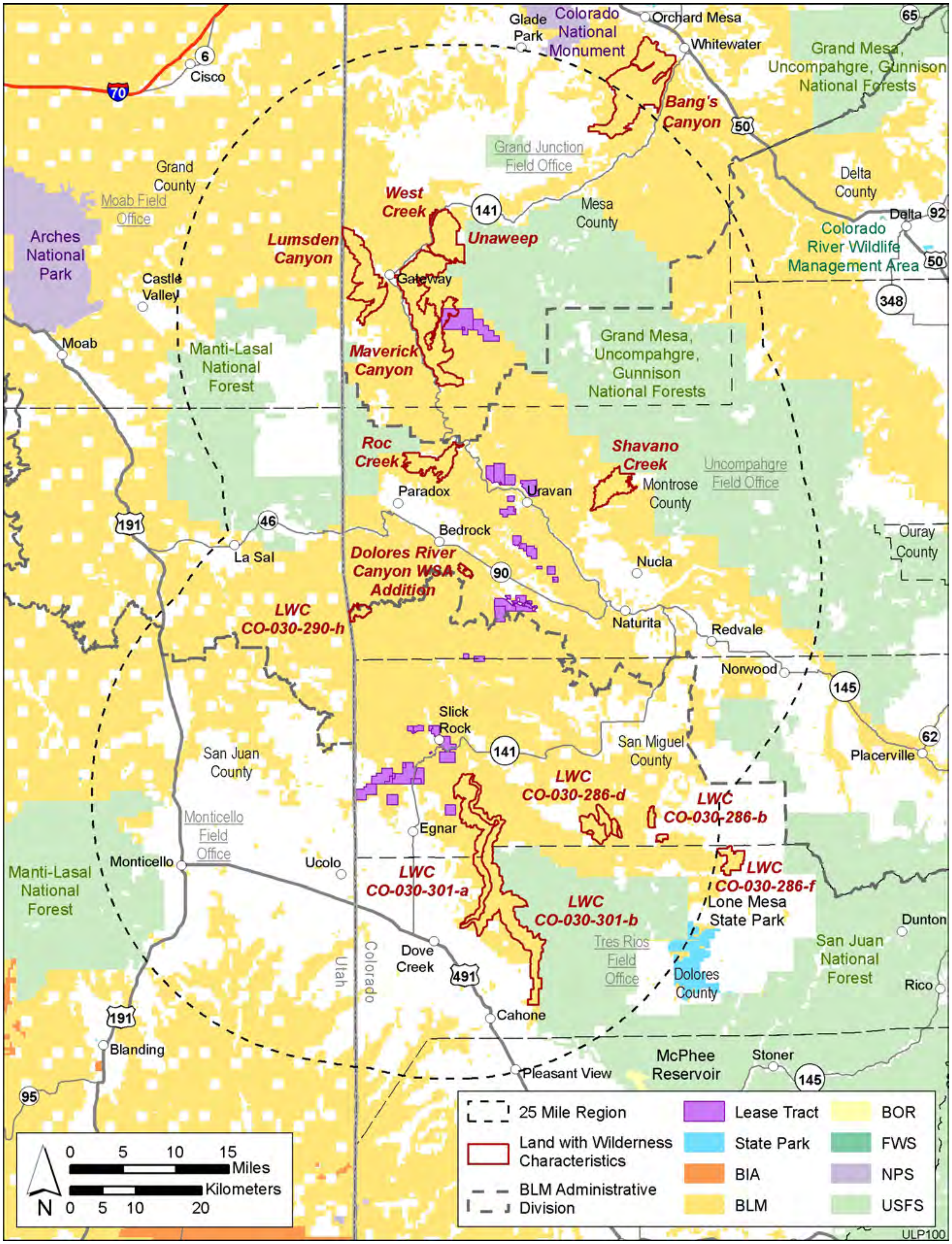

FIGURE 3.7-2 Land with Wilderness Characteristics near the ULP Lease Tracts

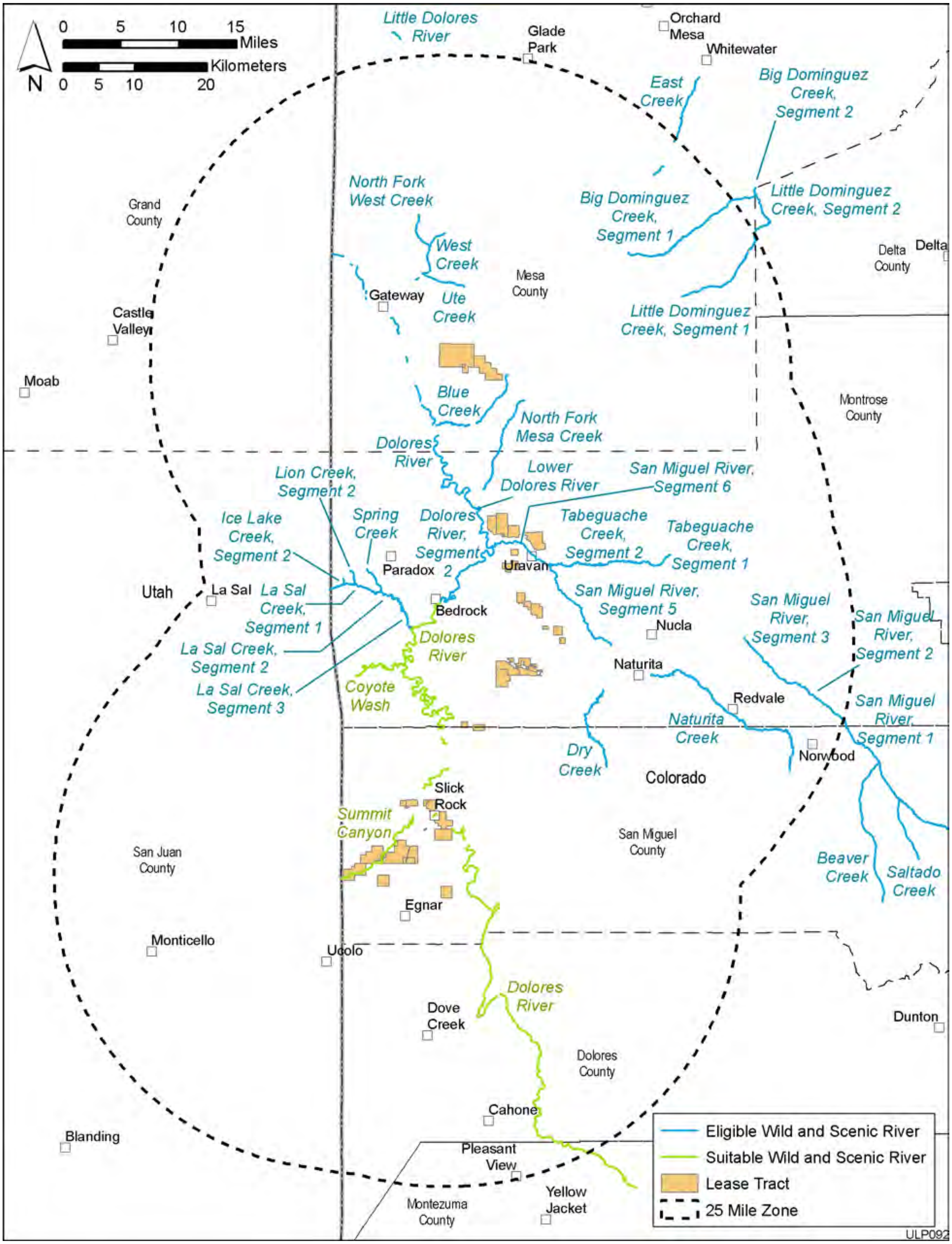

FIGURE 3.7-3 Wild and Scenic River Segments near the ULP Lease Tracts

TABLE 3.7-3 Eligible Wild and Scenic River Segments within 25 mi (40 km) of the ULP Lease Tracts[a]

	Ownership		
River Segment (Classification)	River Segment (mi)	Within 0.5-mi-wide Corridor (acres)	ORVs[b]
Grand Junction Planning Area			
Dolores River Watershed			
Dolores River (Recreational)	32.01 (total), 18.62 (BLM)	NA[b]	Scenic, recreational, geological, paleontological, and fish.
North Fork Mesa Creek (Scenic)	2.05 (BLM)	NA	Vegetation
Blue Creek (Scenic)	11.36 (total), 10.08 (BLM)	NA	Scenic, fish, and cultural
Dominguez Canyons			
Big Dominguez Creek, Segment 1 (Wild)	15.86 (BLM)	NA	Scenic, recreational, wildlife, geological, and cultural
Big Dominguez Creek – Segment 2 (Scenic)	0.78 (BLM)	NA	Scenic, geological, wildlife, and cultural
Little Dominguez Creek, Segment 1 (Wild)	13.14 (BLM)	NA	Scenic, geological, wildlife, and cultural
Little Dominguez Creek, Segment 2 (Scenic)	2.45 (BLM)	NA	Scenic, geological, wildlife, and cultural
Little Dolores River			
Little Dolores River (Scenic)	20.03 (total), 1.1 (BLM)	NA	Cultural and scientific
Unaweep Canyon			
East Creek (Recreational)	20.26 (total), 8.96 (BLM)	NA	Geological
West Creek (Recreational)	23.56 (total), 4.93 (BLM)	NA	Scenic, geological, wildlife, and vegetation
North Fork West Creek (Wild)	8.46 (total), 3.31 (BLM)	NA	Scenic

TABLE 3.7-3 (Cont.)

	Ownership		
River Segment (Classification)	River Segment (mi)	Within 0.5 mi-wide Corridor (acres)	ORVs[b]
Unaweep Canyon (Cont.)			
Ute Creek (Scenic)	4.22 (total), 4.19 (BLM)	NA	Vegetation
Uncompahgre Planning Area			
San Miguel Hydrologic Unit			
Dry Creek (Wild)	10.42 (BLM), 0.07 (State)	2,760.4 (BLM), 80.7 (State), 2.8 (Private)	Scenic and geologic
Naturita Creek (Scenic)	9.9 (BLM), 14.98 (Private)	3,238.5 (BLM), 2.3 (USFS), 3,176.6 (Private)	Fish
San Miguel, River Segment 1 (Recreational)	17.34 (BLM), 0.08 (USFS), 9.81 (Private)	6,679.2 (BLM), 136.0 (USFS), 1628.8 (Private)	Scenic, recreational, wildlife, historic, vegetation, and paleontological
San Miguel, River Segment 2 (Wild)	3.64 (BLM), 0.37 (USFS)	1,112.0 (BLM), 122.7 (USFS), 21.3 (Private)	Scenic, recreational, wildlife, and vegetation
San Miguel, River Segment 3 (Scenic)	5.30 (BLM), 2.01 (Private)	1,880.7 (BLM), 407.6 (Private)	Recreational, fish, wildlife, and vegetation
San Miguel, River Segment 5 (Recreational)	2.59 (BLM), 11.41 (Private)	2,738.1 (BLM), 1,610.4 (Private)	Recreational, fish, historic, and vegetation
San Miguel, River Segment 6 (Recreational)	2.25 (BLM), 0.98 (Private)	808.7 (BLM), 180.7 (Private)	Recreational, fish, historic, and vegetation
Tabeguache Creek, Segment 1 (Wild)	3.61 (BLM)	1,077.0 (BLM), 6.3 (Private)	Vegetation
Tabeguache Creek, Segment 2 (Recreational)	7.89 (BLM), 3.68 (Private)	2,487.3 (BLM), 515.4 (Private)	Cultural and vegetation

TABLE 3.7-3 (Cont.)

River Segment (Classification)	Ownership: River Segment (mi)	Ownership: Within 0.5 mi-wide Corridor (acres)	ORVs[b]
Lower Dolores Hydrological Unit			
Lower Dolores River (Scenic)	6.93 (BLM), 3.60 (Private)	2,197.5 (BLM), 922.7 (Private)	Scenic, recreational, geologic, fish, and wildlife
North Fork Mesa Creek (Scenic)	5.81 (BLM), 2.72 (Private)	2,042.4 (BLM), 424.5 (Private)	Vegetation
Upper Dolores Hydrological Unit			
Dolores River, Segment 2 (Recreational)	5.42 (BLM), 6.08 (Private)	1,820.7 (BLM), 1,423.8 (Private)	Scenic, recreational, geologic, fish, wildlife, and vegetation
Ice Lake Creek, Segment 2 (Scenic)	0.31 (BLM), 0.27 (Private)	104.8 (BLM), 75.8 (Private)	Scenic
La Sal Creek, Segment 1 (Scenic)	0.62 (BLM), 4.20 (Private)	718.1 (BLM), 630.8 (Private)	Fish, vegetation
La Sal Creek, Segment 3 (Wild)	3.37 (BLM)	907.7 (BLM)	Scenic, recreational, fish, cultural, and vegetation
Lion Creek, Segment 2 (Scenic)	1.26 (BLM), 0.31 (Private)	401.5 (BLM), 84.7 (Private)	Vegetation
Spring Creek (Recreational)	1.49 (BLM), 1.16 (Private)	633.0 (BLM), 201.4 (Private)	Vegetation
Tres Rios–San Juan Planning Area			
Dolores River – McPhee to Bedrock	109.02	NA	Wildlife, scenic, recreational
Summit Canyon	12.15	NA	Scenic
Coyote Wash	7.60	NA	Wildlife

[a] River segments in the Tres Rios Planning Area are designated "suitable" for wild and scenic rivers status.

[b] ORVs are river-related values that are unique, rare, or exemplary; these include scenic, recreational, geologic, fish, wildlife, cultural, historical, vegetation, or other similar values (such as paleontological and scientific).

Sources: BLM (2009d, 2010e); USFS and BLM (2013)

TABLE 3.7-4 Number of Farms and Acreage of Agricultural Lands by County

	Acreage of Agricultural Lands by County				
Agriculture Lands	Mesa	Montrose	San Miguel	Grand	San Juan
Number of farms	1,767	1,045	123	90	758
Average farm size	211	307	1,227	561	2,041
Total land in farms	372,511	321,056	150,947	52,729[a]	1,546,914
Total cropland	131,178	93,262	17,807	7,956	143,231
Harvested	47,438	60,094	6,769	3,623	48,168
Pasture/grazing	68,769	27,740	5,104	NA[b]	14,999
Other (fallow, etc.)	14,971	5,428	5,934	NA	80,064
Total woodland	30,223	25,698	15,013	623	34,606
Pastured	25,106	21,237	13,470	NA	20,196
Not pastured	5,117	4,461	1,543	NA	14,410
Permanent pasture and rangeland	197,682	179,935	115,143	37,109[a]	1,360,534
Land in farmsteads, buildings, livestock facilities, ponds, roads, wasteland, etc.	13,428	22,161	2,984	3,012	8,543
Pastureland, all types	291,557	228,912	133,717	40,355[a]	1,414,748
Irrigated land	64,272	85,656	12,694	4,712	5,177

[a] Data for Grand County are from the 2002 census (2007 data were withheld to avoid disclosing data for individual farms).

[b] NA = not available (2007 data were withheld to avoid disclosing data on individual farms).

(9.5%), woodland (2.2%), and land in farmsteads, buildings, and livestock facilities (<1%). Only a small portion of cropland (6.5%) in Grand and San Juan Counties is irrigated.

There are 329,000 acres (1,300 ha) of farmland estimated to be within 25 mi (40 km) of the ULP lease tracts; most of this land occurs to the southwest of the lease tracts in San Juan County (Utah) and Dolores County (Colorado). There are no agricultural activities associated with any of the ULP lease tracts. A few soil types within the ULP lease tracts have been classified by the NRCS as prime or unique farmland, if irrigated (see Section 3.3.2).

3.7.3 Rangeland Resources

3.7.3.1 Livestock Grazing

Domestic livestock grazing is a major and widespread use of public lands managed by the BLM. Grazing on public land is authorized either through a grazing permit or lease issued by the BLM to local ranchers. The BLM administers its grazing program in accordance with the Taylor Grazing Act of 1934; regulations governing grazing are contained in 43 CFR Part 4100. As of October 2010, the BLM had issued 1,510 grazing permits and leases in Colorado (BLM 2011h).

The lease tracts provide some forage for livestock grazing but do not support concentrated grazing. The BLM has determined that in the lease tracts, 30 to 50 acres (12 to 20 ha) of forage constitute one animal unit month (AUM). Nearly all the lease tracts are within areas designated by the BLM as livestock management areas for cattle or sheep (Hurshman 1994; USFS and BLM 2013).

3.7.3.2 Wild Horses and Burros

The Wild Free-Roaming Horse and Burro Act of 1971 (16 USC 1331 *et seq.*) (the Act) gave the BLM and other Federal land management agencies the responsibility for protecting, managing, and controlling wild horses and burros. The general objectives for managing wild horses and burros are to (1) protect, maintain, and control viable, healthy herds with diverse age structures while retaining their free-roaming nature; (2) provide adequate habitat through the principles of multiple use and environmental protection; (3) maintain a thriving natural ecological balance with other resources; (4) provide opportunities for the public to view wild horses and burros; and (5) protect wild horses and burros from unauthorized capture, branding, harassment, or death.

Wild horses and burros are managed within herd management areas (HMAs), with the goal being to maintain both the natural ecological balance of public lands and the ability to support multiple herds (BLM 2011i). An HMA is usually some portion of a herd area (HA), which is an area that was wild horse or burro habitat at the time of the passage of the Act but has not been designated for long-term management of wild horses or burros. The exterior boundaries of both HAs and HMAs can include private or state lands, but the BLM has management authority over only the public lands. Herd population management is important for balancing herd numbers with forage resources and with other uses of the public and adjacent private lands.

There are four HAs in Western Colorado. These occur in Rio Blanco, Mesa, Montrose, and San Miguel Counties. There are also four HMAs, but only three coincide with the HAs: Piceance-East Douglas Creek (Rio Blanco County); Little Book Cliffs (Mesa County); and Spring Creek Basin (San Miguel County). Another HMA, Sand Wash Basin, is located in Moffat County. The HMA nearest to the lease tracts is in Spring Creek Basin, about 20 mi (32 km) to the east of the Slick Rock lease tract (on the east side of Disappointment Valley). There is an HA that straddles the Montrose-San Miguel County line in the canyons south of Paradox Valley near the southern part of the Paradox lease tract.

3.7.4 Mineral Resources and Mining

Mineral resources in southwestern Colorado and southeastern Utah include uranium, vanadium, oil, natural gas, coal, and other metallic and nonmetallic minerals and mineral materials (Figure 3.7-4). These resources are discussed in the following subsections.

3.7.4.1 Uranium

As of June 13, 2011, there were 32 actively permitted uranium mining projects in southwestern Colorado, none of which were producing ore (CDNR 2011). The mines and their status are shown in Table 3.7-5; 15 of the permitted projects in Colorado are in the lease tracts (in Mesa, Montrose, and San Miguel Counties). The most recent ore production occurred at three mines operated by Denison Mines (USA) Corporation in San Miguel County, which operated from 2007 to 2009. Uranium prospecting activities have declined in recent years,[20] but the CDNR expects an increase in these activities once the Piñon Ridge Mill in Paradox Valley is constructed.

There were 23 uranium projects in Utah in 2010, a few of which were producing ore (UGS 2011). The mines and their status are shown in Table 3.7-6; most of the projects in Utah are in the lease tracts area (in Grand and San Juan Counties). Two mines operated by Denison Mines (USA) Corp. (Pandora and Beaver Mines) in San Juan County produced 371,700 lb (168,600 kg) of U_3O_8 and 2,080,000 lb (943,500 kg) of V_2O_5 in 2010. White Canyon's Daneros Mine (also in San Juan County) also produced uranium ore in 2010 (UGS 2011).

According to the BLM's Land and Mineral Rehost 2000 System (LR2000), accessed on September 10 and 11, 2012, there are several authorized notices of intent and one plan of operation on file with the BLM for uranium- and vanadium-related mining activities within or immediately adjacent to the lease tracts; these include:

- *Gateway lease tract*. One notice of intent (COC 071901) filed by Rimrock Exploration and Development, Inc. for uranium mining on a claim in the vicinity of Lease Tract 27, in section 13 of T50N, R18W; operations authorized in 2008.

- *Uravan lease tract*. One notice of intent (COC 071888) filed by Energy Fuels Resources Corp. for uranium and other minerals mining on claims that are adjacent to Lease Tract 25 in sections 5 and 6 of T47N, R17W; operations authorized in 2009.

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[20] As measured by the number of uranium prospecting notices of intent filed with the state (CDNR 2011).

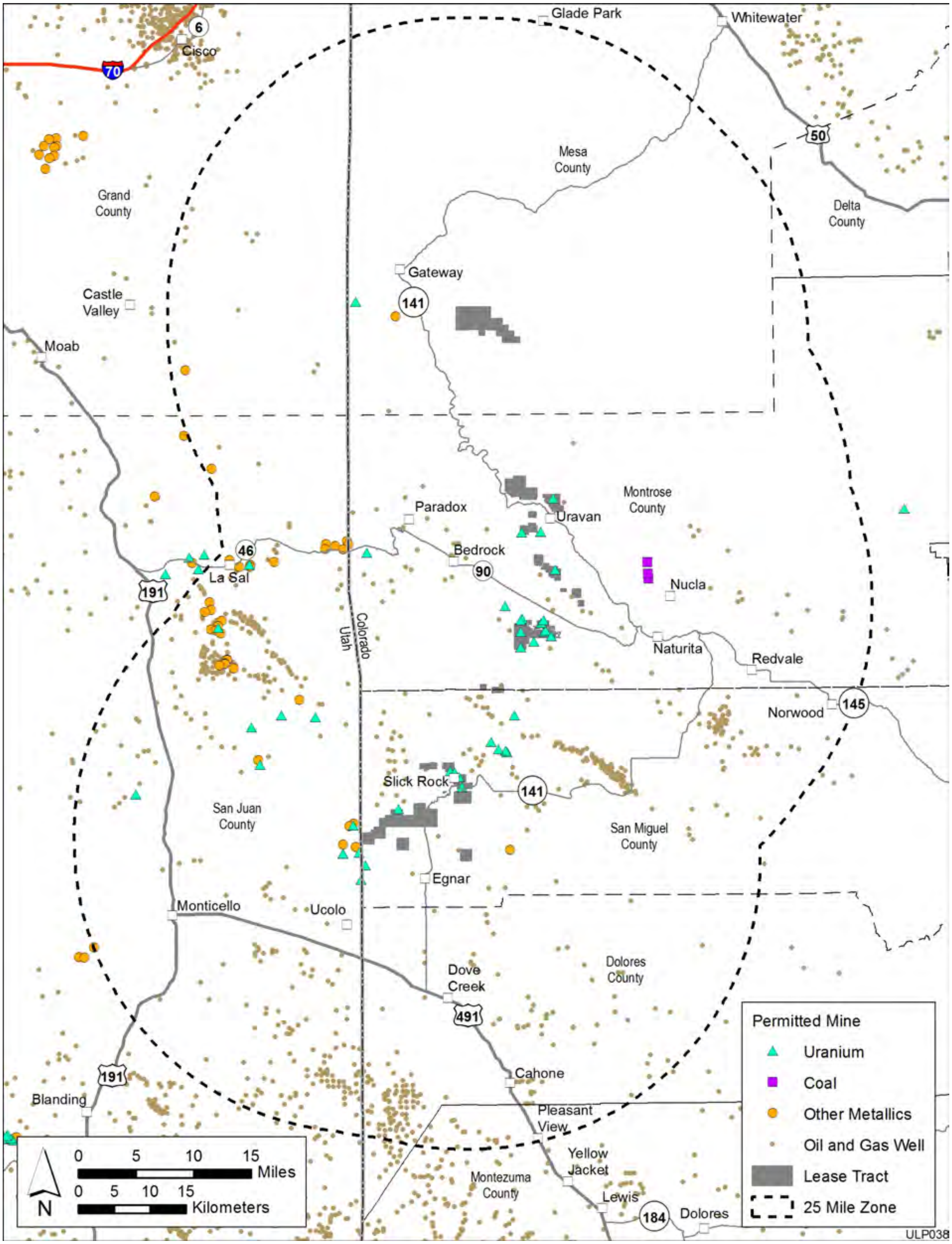

FIGURE 3.7-4 Permitted Oil and Gas Wells and Mines within 25 mi (40 km) of the ULP Lease Tracts

1 **TABLE 3.7-5 Active Uranium Mining Permits in Southwestern Colorado**

Site Name	Permittee	County	Permit/Site Status[a]
C-JD-5[b]	Gold Eagle Mining, Inc.	Montrose	INT/Maintenance
Mineral Joe Claims	Cotter Corporation	Montrose	INT/Tied to JD-6 Mine
Sunday Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
Deremo-Snyder	Umetco Minerals Corporation	San Miguel	INT/Reclaimed
Monogram-Jo Dandy	Nuvemco, LLC	Montrose	INT/Maintenance
Burros Mine[b]	Gold Eagle Mining, Inc.	San Miguel	INT/Maintenance
C-LP-21 Mine[b]	Cotter Corporation	Montrose	INT-TC/Reclaimed
JD-9 Mine[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
CM-25 Mine[b]	Cotter Corporation	Montrose	INT/Reclaimed
C-JD-7[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
JD-6 Mine[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
SR-13A Mine[b]	Cotter Corporation	San Miguel	INT-TC/Reclaimed
Carnation Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
Sego Mine	Sutherland Drilling	San Miguel	INT/Maintenance
Ike No. 1 Mine[b]	Cotter Corporation	San Miguel	INT/Maintenance
Tramp Mine	Bluerock Energy Corp.	Montrose	INT/Maintenance
St. Jude Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
SM-18 Mine[b]	Cotter Corporation	Montrose	INT/Maintenance
Monogram Mines	Nuvemco, LLC	Montrose	INT/Maintenance
Hawkeye Mine[b]	Gold Eagle Mining, Inc.	San Miguel	INT/Maintenance
Ellison Mine[b]	Gold Eagle Mining, Inc.	San Miguel	INT/Maintenance
JD-7 Pit[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
Wright Group[b]	Cotter Corporation	Montrose	INT/Maintenance
Topaz Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
West Sunday Mine	Denison Mines (USA) Corp.	San Miguel	INT-TC/Maintenance
C-JD-8[b]	Cotter Corporation	Montrose	INT-TC/Maintenance
Centennial	B-Mining Company	San Miguel	INT/Maintenance
Van 4 Shaft	Denison Mines (USA) Corp.	Montrose	AC/Maintenance
J Birds	Rimrock Exploration and Development, Inc.	Montrose	INT/Maintenance
Whirlwind Mine	Energy Fuels Resources Corp.	Mesa	INT/Maintenance
Last Chance #3 and #4	Nuvemco, LLC	Montrose	AW
October Ore Pile Reclamation	Nuvemco, LLC	Mesa	AC/Maintenance

[a] The status listed is as of March 2014. AC = active; AW = awaiting warranty; TC = temporary cessation; and INT = intermittent. Maintenance includes general upkeep as required for operations with intermittent (INT) status or temporary cessation (TC) status, but it does not include development or production activities.

[b] Mines that are on the DOE ULP lease tracts.

Source: CDNR (2011)

TABLE 3.7-6 Uranium Projects in Southeastern Utah, 2010[a]

Site Name	Permittee	County	Site Status
Whirlwind	Energy Fuels Resources Corp.	Grand	Permitted resource
Thompson Project	Energy Fuels Resources (USA) Inc.	Grand	Acquired 6,672 acres; exploration project
Dunn Mine	Energy Fuels Resources (USA) Inc.	San Juan	Resource quantified
Rim-Columbus	Energy Fuels Resources (USA) Inc.	San Juan	Permitted resource
Marcy-Look	Energy Fuels Resources (USA) Inc.	San Juan	Acquired 907 acres; exploration project
Blue Jay	Energy Fuels Resources (USA) Inc.	San Juan	Acquired 289 acres; exploration project
Energy Queen (Hecla Shaft)	Energy Fuels Resources Corp.	San Juan	Permitted resource
North La Sal	Vane Minerals PLC	San Juan	Acquired 80 acres
North Alice Extension	Vane Minerals PLC	San Juan	Resource quantified
Pandora/Snowball/Beaver	Energy Fuels Resources (USA) Inc.	San Juan	Standby mode
DAR-RAD	West Lisbon LLC	San Juan	1,000 acres of property
Lisbon Mine	Mesa Uranium Corp.	San Juan	22 holes completed
Velvet	Uranium One, Inc.	San Juan	Resource quantified
Calliham (J.H. Ranch)	Energy Fuels Resources Corp.	San Juan	Resource quantified
Crain	Energy Fuels Resources Corp.	San Juan	Resource quantified
Daneros (Lark Royal)	Energy Fuels Resources (USA) Inc.	San Juan	Standby mode
Geitus	Energy Fuels Resources (USA) Inc.	San Juan	Resource quantified
Happy Jack	Vane Minerals PLC	San Juan	22 holes completed
LaSal II	Laramide Resources, Ltd.	San Juan	Permitted resource

[a] Table lists only projects occurring in San Juan and Grand Counties because these are the only Utah counties within 25 mi (40 km) of the DOE ULP lease tracts in which uranium projects are located.

Source: UGS (2011); White (2014)

- *Paradox Valley lease tract*. One plan of operation (COC 062522) filed by Energy Fuels Resources Corp. for uranium mining on claims immediately adjacent to Lease Tract 9 in section 29 of T46N, R17W; operations authorized in 1998. Two notices of intent (COC 070985 and 072947) filed by Energy Fuels Resources Corp. for uranium and other mining in the same section; operations authorized in 2007 and 2008, respectively.

- *Slick Rock least tract*. One plan of operation (COC 052755) filed by Umetco Minerals Corp. for vanadium mining on claims that are adjacent to Lease Tract 13 in sections 29 and 30 of T44N, R18W; operations authorized in 1993.

3.7.4.2 Coal

Coal-bearing areas in the Colorado Plateau region are extensive, and many of these areas (about 50%) occur beneath lands administered by various Federal agencies (BLM, National Park Service [NPS], and USFS). About 23% of the areas are beneath Native American tribal lands; another 26% are administered by state agencies or are privately owned (USGS 2001). In 2011, Colorado counties within 25 mi (40 km) of the ULP lease tracts produced about 2.6 million tons of coal from both surface and underground mines, with most of the production coming from Delta County (CDRMS 2011).[21] During that same year, there was no coal production in the two Utah counties (Grand and San Juan) within 25 mi (40 km) of the lease tracts (most coal production in Utah is to the west, in Carbon and Emery Counties) (UGS 2012).

According to the LR2000, accessed on September 10 and 11, 2012, there are no coal leases within any of the 31 ULP lease tracts (BLM 2012b). The New Horizon Mine (operated by Western Fuels Association, Inc.), located near Nucla in Montrose County about 10 mi (16 km) to the east of Paradox Valley, is the only active coal mine near the lease tracts. The surface mine is located in the Nucla-Naturita coal field that produces coal from minable coal beds in the Dakota Sandstone.[22] The mine is the exclusive supplier of coal to Nucla Station power plant, a 100-MW power plant located about 3 mi (4.8 km) southeast of Nucla. The New Horizon Mine produced 360,000 tons of coal in 2011, a 23% increase over production in 2010 (CDRMS 2012d, e). Coal production at the New Horizon Mine is expected to continue for the life of the power plant (Montrose County 2010).

3.7.4.3 Oil and Gas

Oil production and natural gas production in the region are concentrated in the Paradox Basin, especially along the Colorado–Utah border (Figure 3.7-4). In 2011, Colorado counties within 25 mi (40 km) of the ULP lease tracts produced 255,000 barrels (bbl) of oil and 314,000,000 million cubic feet of natural gas (including coalbed methane), with most of the production coming from Montezuma County (COGCC 2012a). During that same year, 3,580,000 bbl of oil and 11,300,000 million cubic feet of natural gas were produced in the two Utah counties (Grand and San Juan) within 25 mi (40 km) of the lease tracts (an 11% and 21% decline in production from the previous year, respectively) (UDOGM 2012).

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[21] Coal production was estimated by adding the production numbers reported in CDRMS (2011) for counties falling within 25 mi (40 km) of the ULP lease tracts. Coal production estimates are from Delta and Montrose Counties only; several counties within this range did not produce coal in 2011; these include Mesa, San Miguel, Dolores, and Montezuma Counties.

[22] The mine produces coal from three coal beds in the Dakota Sandstone with thicknesses of about 3 to 5 ft (0.9 to 1.5 m). Although the coal-bearing formation extends into surrounding counties (Dolores, Mesa, Montezuma, Ouray, and San Miguel), it is not considered important for exploitation, because the coal beds are generally thin and discontinuous (Kirschbaum and Biewick 2012).

There are authorized oil and gas leases within most of the lease tracts.[23] According to the LR2000, accessed September 10 and 11, 2012, most of the oil and gas leases are located along the Dolores River Canyon in the Slick Rock lease tracts (San Miguel County); there are also several leases in the Uravan and Paradox lease tracts, but none in the Gateway lease tract (BLM 2012c). None of the oil and gas leases in the lease tracts have produced oil or gas (COGCC 2012b). There is one pending notice for geophysical exploration activities in the Paradox lease tract, associated with oil and gas leases that overlap Lease Tracts 17-1 and 17-2 in sections 14 and 15 of T45 N, R18W (on Radium Mountain and Wedding Bell Mountain, respectively) (BLM 2012b).

3.7.4.4 Other Minerals and Mineral Materials

In addition to uranium and vanadium, metallic minerals mined in the Colorado counties within 25 mi (40 km) of the ULP lease tracts include gold, silver, platinum (San Miguel County only), lead, zinc, copper, cadmium, and rare earths (Montrose County only). Non-metallic minerals include gypsum and potash (CDRMS 2012e). According to the LR2000, accessed September 10 and 11, 2012, there are four pending potash permits within some of the Slick Rock lease tracts: one pending permit (COC 073566) is located in section 27 of T44N, R19W, which slightly overlaps Lease Tract 15A; two pending permits (COC 073567 and COC 073568) cover most of sections 10, 11, and 14 through 16 of T43N, R19W, in Lease Tracts 16 and 16A; and one pending permit (COC 073572) is located in section 32 of 43N, R18W, in Lease Tract 12 (BLM 2012b).

Mineral materials of commercial value mined in the region include sand and gravel, crushed stone, dimension stone, granite, limestone, sandstone (silica, stone, and quartz), shale, clay, and aggregate (CDRMS 2012e). There is only one authorized mineral material site (for common clay) within all the ULP lease tracts. The site is located on 9 acres (3.6 ha) in Lease Tract 25, in the northeast quadrant of section 5 in T47N, R17W (COC 069589; Umetco Minerals Corp., permittee). No other mineral material contracts or free use permits occur within the lease tracts (BLM 2012b).

3.7.5 Timber Harvest

In 2002 (the latest year for which county-level data are available), the timber harvest in Colorado counties within 25 mi (40 km) of the ULP lease tracts (Mesa, Montrose, and San Miguel) was an estimated 13 million board feet, accounting for about 16% of Colorado’s timber production during that year. The leading species harvested in Colorado, in decreasing order, were ponderosa pine (31%), spruce (Engelmann and blue spruce; 25%), lodgepole pine

[23] The ULP lease tracts are located on BLM lands that are withdrawn from mineral entry. The lands remain open to mineral leasing and the mineral material laws.

(17%), aspen and cottonwood (14%), and douglas fir (10%). Most of these species were harvested for sawlogs. The timber harvest on public lands in Colorado has been in decline since 1982 (with an increasing share being provided by private and tribal land owners) (Morgan et al. 2006).

The timber harvest in Utah counties within 25 mi (40 km) of the ULP lease tracts (Grand and San Juan) was estimated to be about 1.5 million board feet, accounting for only about 3.6% of Utah's timber production in 2002. The leading species harvested in Utah, in decreasing order, were spruce (44%), lodgepole pine (23%), ponderosa pine (13%), aspen and cottonwood (10%), and douglas fir (8%). Most of these species were harvested for sawlogs and house logs. Although National Forests still provide the majority of the state's harvest in Utah, timber harvest on public lands in the state has been in decline since 1992 (with an increasing share being provided by private and tribal land owners) (Morgan et al. 2006).

There are an estimated 3,900 acres (16 km^2) of harvested forest land within 25 mi (40 km) of the ULP lease tracts; most of this land is concentrated along the southwestern edge of the Uncompahgre Plateau and Piñon Mesa to the northeast and the La Sal Mountains to the west (in Utah). Although there is no commercial timber harvesting within the ULP lease tracts, the lease tracts and adjacent public lands provide piñon pine and juniper trees for small-scale harvesting to use as firewood, fence posts, and Christmas trees. In addition, commercial timbering was conducted in 2009 on Pine Mountain, north of Lease Tract 26.

3.7.6 Recreation

BLM-designated SRMAs are areas where the principal land management priority is recreation. There are several SRMAs within 25 mi (40 km) of the ULP lease tracts (Figure 3.7-1). These include Bangs Canyon and Dolores River in Colorado, and Cameo Cliffs, Canyon Rims, Colorado Riverway, San Miguel River, Dolores River, Dolores River Canyons, Indian Creek, and Two Rivers in Utah (Table 3.7-1). The SRMA nearest to the lease tracts is a 100-river mile (160-km) segment of the Dolores River that flows northward from the McPhee Reservoir in Montezuma County to Bedrock in Paradox Valley. The SRMA cuts through the Slick Rock lease tracts area and is a popular rafting destination from late April to early June, except during very dry years (BLM 2010d). Many segments and tributaries of the Dolores and San Miguel Rivers (and others) in the region are designated as WSRs on the basis of numerous ORVs that include recreational value (Figure 3.7-2; Table 3.7-2).

The Gateway area and surrounding Unaweep Canyon have undergone development in recent years to promote recreational activities in the area. Tourism and activities related to the Gateway Canyons Resort (e.g., river rafting) are expected to increase, especially in the summer months.

The Paradox Valley area along Long Park Road (County Road EE22) is a popular location for rock climbing. The Paradox Trail is a 100-mi (160-km), two-track path along the Dolores River that links to the Tabeguache Trail on the Uncompahgre Plateau (to the east) with the Kokopelli Trail in the La Sal Mountains of Utah (to the west). Together, these trails form a

"Grand Loop" of 360 mi (580 km) of back country mountain bike trails. The trail is accessible by mountain bike from May through November; only parts of the trail are accessible by two-wheel drive vehicles (BLM 2011k).

There are developed recreation sites along the San Miguel River and Dolores River SRMAs, including campsites, boat ramps, picnic areas, parking areas, restrooms, and boat ramps. Recreational activities in these areas include off-highway vehicle (OHV) riding (such as four-wheel drive, motorcycle, ATV, and the like), hiking, camping, hunting, mountain biking, horseback riding, recreational mining, fishing, rafting, and kayaking (BLM 2011k).

The Unaweep Tabeguache Byway (Highways 141 and 145) offers opportunity for scenic and historic touring in the region. The byway runs from Whitewater through Gateway, Naturita, Norwood, and Placerville (Figure 3.7-1). Sites along the byway include the Grand Valley Overlook, the Driggs Mansion, Gateway Community Park, the Hanging Flume Overlook, and the San Miguel River Nature Conservancy Preserve (CDOT 2012).

3.8 SOCIOECONOMICS (INCLUDING TOURISM AND RECREATION)

The use of Federal lands for uranium mining affects local communities in the project area by changing demographic characteristics and local economies and altering social structures. The ROI referred to here includes the area that could be affected by uranium mining on the 31 DOE ULP lease tracts and where workers are expected to reside and spend their wages. For this analysis, the ROI includes the counties where the 31 DOE ULP lease tracts are located: Mesa County; Montrose County; and San Miguel County in western Colorado. These lease tracts are located in the westernmost portions of all three counties. For the ROI, three economic indicators are described: employment; unemployment; and personal income. Measures of social activity considered include population, housing, public service employment, and levels of service for education (schools), healthcare, and public safety.

For the most part, the communities within the ROI are rural in nature; the exception is the larger town of Grand Junction. The town nearest the DOE ULP lease tracts in Mesa County is Gateway, an unincorporated town of approximately 650 people that lies 6 mi (9.7 km) to the northwest of the lease tracts. The closest incorporated areas in Mesa County are at least 30 mi (48 km) to the northeast of the potential lease tracts. In Montrose County, the unincorporated towns of Bedrock and Paradox are located 7 mi (11 km) and 9 mi (14 km) to the west of the lease tracts, respectively. The larger towns closest to the lease tracts are Nucla and Naturita, at a distance of 7 to 8 mi (11 to 13 km). The population in San Miguel is concentrated almost entirely in the eastern portion of the county; the lease tracts are located about 43 mi (69 km) west of the populated areas, near the border with Utah.

Two recent studies have estimated the economic impacts of uranium mining in western Colorado. Economic and Planning Systems (EPS) used data from a mining operations plan and the associated socioeconomic impact analysis prepared for an application from Energy Fuels Resource Corp. to describe the impacts of a uranium mining project in Montrose County (EPS 2010). Beginning in 2012, up to 500 tons of ore per day (175,000 tons annually) would be produced by 2020, involving between 5 and 9 mines and the operation of a new mill at Piñon Ridge. If half of the uranium mining, milling, and transportation activity occurred in Montrose County, Energy Fuels Resource Corp. estimated that approximately 200 direct jobs, paying an average of $60,000 per job, and about 500 total jobs (direct plus indirect plus "induced" jobs [the indirect jobs estimated using an IMPLAN model]) would be produced in the county beginning in 2020. If all mining, milling, and transportation activities were located in Montrose County, 315 direct and up to 650 total jobs would be created.

Power Consulting (2010) suggested that the number of direct jobs created at a new uranium mill would be significantly smaller than those estimated in the EPS report, numbering only about 70, and that the total number of jobs (direct plus indirect plus induced) would be 120, as it can only be assumed that a small percentage of mine and mill workers would reside in Montrose County, with few of the projected mill jobs being filled by unemployed workers living in the county. Power Consulting also suggested that many of the industries supplying the uranium resource developments would be located outside the county, and that a small proportion of the uranium supplying the Piñon Ridge Mill would be mined in the county, resulting in reduced positive economic impacts in the county. Power Consulting also suggested that the generation of radioactive waste might discourage the location of new economic activity in the county, particularly income from tourism and retirees, and that economic activity at a level comparable with the development of new mines and milling could be created through uranium mine reclamation activities. Finally, it also suggested that volatility in uranium markets (and the impact this would have on uranium employment in Montrose County) might produce a "boom-and-bust" scenario, creating instability in local labor markets, causing social disruption, and undermining the ability of local governments to plan with regard to providing public and educational services.

Western Colorado has experienced past boom and bust periods from uranium mining activities. The uranium industry's first boom occurred in the 1950s and crashed after 1970 when the Federal Government phased out financial subsidies. Another boom driven by the expansion of nuclear power in the mid-1970s led to the height of the uranium boom. By the early 1980s, the United States stopped building new nuclear power plants, the price of uranium dropped dramatically, and the uranium boom ended. The boom and bust effects from uranium mining had varying impacts on individual communities. Much of western Colorado began to diversify its economy in the 1980s, focusing on recreation and tourism opportunities.

Taken in its entirety, the population growth rate in the ROI between 1960 and 2010 was generally greater than the average U.S. population growth rate over the same period. The period between 1960 and 1970 was the only 10-year period in which the ROI counties had a lower growth rate than the U.S. average, and the only period in which the population of one of the counties (San Miguel County) fell from the previous decade. Figure 3.8-1 presents the population trend in the ROI over the 50-year period between 1960 and 2010. Although the overall population of the ROI was not greatly affected by uranium mining, the west end of Montrose County lost almost 60% of its population between 1960 and 1990. The town of Uravan, for example, had 600 residents in 1950 and was shut down entirely by 1986. The population of the west end of San Miguel County increased from fewer than 200 residents to

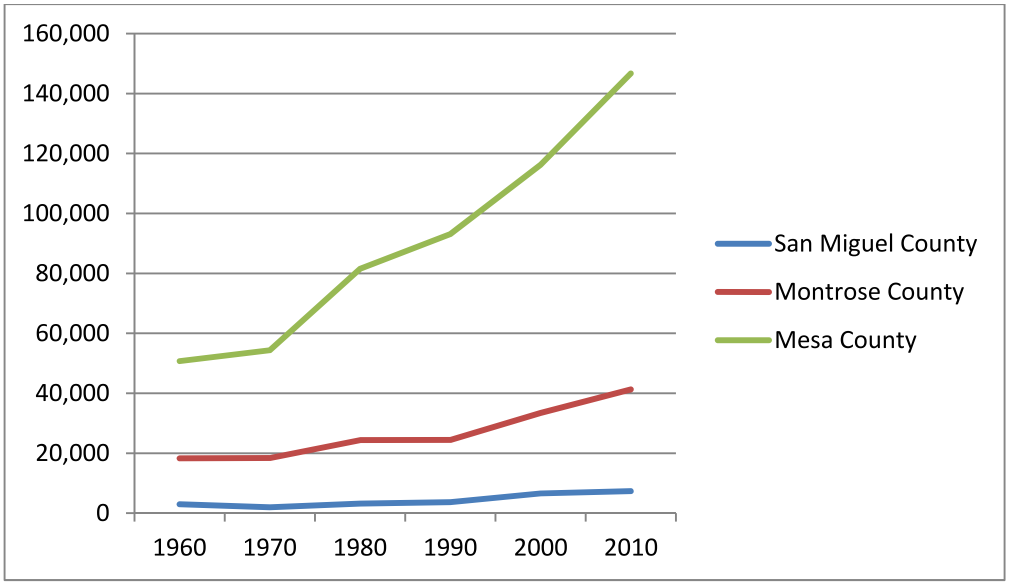


FIGURE 3.8-1 ROI Population from 1960–2010 (Sources: CensusViewer 2013a, b, c; U.S. Bureau of the Census 1995)

more than 1,000 and then collapsed to about 100 residents between 1930 and 1990 (Power Consulting 2010).

3.8.1 Economic Environment

3.8.1.1 ROI Employment and Unemployment

The ROI, like Colorado and the rest of the United States, has experienced an increase in unemployment in recent years. It experienced a sharp rise in unemployment between 2000 and 2010. However, as shown in Table 3.8-1, the overall growth in employment in the ROI (1.9%) was higher than the growth in the state of Colorado as a whole (0.7%). Within the ROI, the average growth rate in employment was higher in Mesa County (2.2 %) than in either Montrose (1.4%) or San Miguel County (0.0%) in the years 2001–2010.

Although the ROI experienced a greater increase in employment during 2001–2010 than did the state as a whole, the unemployment rate was relatively high in the ROI when compared to that of the state of Colorado during the same period (Table 3.8-2). All the counties in the ROI experienced higher rates of unemployment in 2010 and 2011, and during that period, the average unemployment rate was higher in the ROI (10.5% and 9.6%, respectively) than in Colorado as a whole (8.9% and 8.8%). Each county in the ROI experienced a slight decline in the unemployment rate between 2010 and 2011. Unemployment rates in Montrose County were the highest in the ROI in both 2010 and 2011 (11.1% and 11.0%, respectively), while San Miguel County had the lowest unemployment rates in 2010 and 2011 (7.7% and 7.6%, respectively). The

TABLE 3.8-1 ROI Employment, 2001–2010

Location	2001	2010	Average Annual Growth Rate, 2001–2010 (%)
Mesa County	58,066	78,853	2.2
Montrose County	16,203	18,338	1.4
San Miguel County	4,742	4,724	-0.4
ROI	79,011	93,585	1.9
Colorado	2,303494	2,447,712	0.7

Sources: U.S. Department of Labor (2010a,b)

TABLE 3.8-2 ROI and State Unemployment Data, 2001–2011

Location	Average 2001–2010	2010 Average	2011 Average
Mesa County	5.6	10.6	10.3
Montrose County	5.9	11.1	11.0
San Miguel County	4.8	7.7	7.6
ROI	5.6	10.5	9.6
Colorado	6	8.9	8.8

[a] Rates for 2011 are the average for January through September.

Sources: U.S. Department of Labor (2011, 2010a)

unemployment rate for in San Miguel County was also lower than the state average in both 2010 and 2011. Telluride, Colorado, is located in San Miguel County, and the numerous seasonal jobs provided by the ski resort are likely responsible for the lower rates of unemployment. Because Telluride represents 30% of the entire population of San Miguel County, it contributes toward the lower overall unemployment for the county.

3.8.1.2 Employment by Sector

The services industry represents almost 50% of all employment in the ROI because of the high level of recreation and tourism in the area (see Section 3.8.3). Wholesale and retail trade provides the second-highest number of jobs, accounting for 19.7% (Table 3.8-3). Construction jobs make up 8.9% of employment in the ROI. San Miguel County has the highest percentage of people working in the services industry (64.5%), while Montrose has the least, at 41.6%. The Telluride ski area, a popular destination in San Miguel County, brings many service-related jobs to the area. San Miguel County also has a higher percentage of construction-related employment (13%) than either Mesa County (9.8%) or Montrose County (8.3%). Wholesale and retail trade made up the largest percentage of employment in Montrose County (21.4%). Mesa County employed 20.2% of its workforce in wholesale and retail trade, while that category represented only 9.8% of employment in San Miguel County. Montrose County employed a larger percentage of its workforce in agriculture (6.8%) than either Mesa County (3.6%) or San Miguel County (1.3%), which would be expected given that more than 700,000 acres (280,000 ha) in Montrose County is farmland, and the county has been referred to as the agricultural hub of Colorado's Western Slope (USDA 2007b).

3.8.1.3 Personal Income

In general, in 2010 per-capita income was less in the ROI ($34,898) than in the state of Colorado as a whole ($42,582) (Table 3.8-4), and significantly less than the U.S. average ($52,269). In San Miguel County, however, per-capita income in 2010 was $48,611, exceeding the state average. The towns of Sawpit and Telluride, both located in San Miguel County, had the highest median household incomes in the ROI in 2005–2009, which explains the high per-capita income in San Miguel County. The growth rate in Mesa County was higher in 2010 for both total income and per capita income (3.5% and 0.9%, respectively), while growth rates in Montrose County (3.0% and 0.6%) and San Miguel County (2.2% and 0.6%) were slower during that period. The state of Colorado's annual growth rate fell between 2000 and 2009.

At $91,222, Sawpit had the highest median household income in the ROI in 2005–2009, although, with a population of 23 residents, it is also the smallest town in the ROI. In addition to Sawpit, the towns of De Beque, Fruitvale, Fruita, Redlands, Ophir, and Telluride also had average median household incomes higher than the U.S. average of $52,269 during the same period. The town of Naturita had the lowest median household income in the ROI, at $29,452, and it experienced a decline in relative household income from the year 1999. Olathe had the second-lowest median household income ($32,035) and also experienced a moderate decrease in individual earnings from the year 1999. All other towns in the ROI had a median household income of $35,000 or higher in 2005–2009.

The towns of Sawpit and De Beque experienced the largest growth in median household income between 1999 and 2005–2009, although the populations of both towns were quite small (Table 3.8-5). Exactly half (9 out of 18) of the towns in the ROI experienced a decrease in median household income during that period. The largest town in the ROI, Grand Junction, experienced an average annual growth rate in median household income of 0.69%, and the larger towns of Clifton, Fruita, and Montrose experienced growth rates of –0.25%, 2.80%, and 0.30%, respectively. Fruita, which had the fastest population growth rate between 2000 and 2010, also had one of the highest growth rates in median household income in the ROI.

TABLE 3.8-3 ROI Employment by Sector, 2009[a]

	Mesa County, Colorado		Montrose County, Colorado		San Miguel County, Colorado		ROI	
Sector	Employment	% of Total	Employment	% of Total	Employment	% of Total	Employment	% of Total
Agriculture[a]	1,970	3.6	836	6.8	64	1.3	2,870	4.0
Mining[b]	1,619	2.9	114	0.9	60	1.2	1,793	2.5
Construction	4,592	8.3	1,203	9.8	637	13.0	6,432	8.9
Manufacturing	2,593	4.7	1,053	8.6	136	2.8	3,782	5.2
Transportation and public utilities	3,022	5.5	740	6.0	50	1.0	3,812	5.3
Wholesale and retail trade	11,151	20.2	2,628	21.4	470	9.6	14,249	19.7
Finance, insurance, and real estate	3,434	6.2	587	4.8	285	5.8	4,306	6.0
Services	26,739	48.5	5,098	41.6	3,159	64.5	34,996	48.4
Other	10	0.0	10	0.1	38	0.8	58	0.1
Total	55,130		12,269		4,899		72,298	

[a] Agricultural employment includes 2007 data for hired farm workers.

[b] Mining employment includes mining, quarrying, and oil and gas extraction; nonmetallic mineral mining and quarrying; sand, gravel, clay, and ceramic and refractory minerals mining and quarrying; construction sand and gravel mining; coal and metal mining; and support activities for mining.

Sources: U.S. Bureau of the Census (2011a); USDA (2007a)

TABLE 3.8-4 ROI Personal Income, 2000–2009

Location	2000	2009	Average Annual Growth Rate, 2000–2009 (%)
Mesa County, Colorado			
Total income ($ billion 2010)	3.8	5.2	3.5
Per-capita income ($)	32,716	35,362	0.9
Montrose County, Colorado			
Total income ($ billion 2010)	1.0	1.3	3.0
Per-capita income ($)	29,170	30,760	0.6
San Miguel County, Colorado			
Total income ($ billion 2010)	0.3	0.4	2.2
Per-capita income ($)	45,874	48,611	0.6
ROI			
Total income ($ billion 2010)	5.1	6.8	3.3
Per-capita income ($)	32,512	34,898	0.8
Colorado			
Total income ($ billion 2010)	186.2	214.0	1.6
Per-capita income ($)	43,293	42,582	–0.2

Sources: U.S. Department of Commerce (2011)

TABLE 3.8-5 ROI Population, 2000–2023

Location	2000	2010	Average Annual Growth Rate, 2000–2010 (%)	2021	2023
Mesa County	116,255	146,723	2.4	174,681	180,835
Montrose County	33,432	41,276	2.1	56,245	59,228
San Miguel County	6,594	7,359	1.1	10,695	11,349
ROI	156,281	195,358	2.3	241,621	251,412
Colorado	4,301,261	5,160,189	1.8	6,281,388	6,491,972

Sources: U.S. Bureau of the Census (2011c); Colorado State Demography Office (2011)

3.8.2 Social Environment

3.8.2.1 Population

Population in the ROI experienced an average annual growth rate of 2.3% from 2000 to 2010, which was higher than the growth rate in the state of Colorado over the same time period (Table 3.8-5). The average annual growth rate indicates that each year the population in the ROI grew an average of 2.3% each year, over the course of ten years. San Miguel County had the smallest population in the ROI, with a 2010 population of 7,359, while Mesa County had the largest population, at 146,723. Mesa County also had the highest rate of population growth between 2000 and 2010 (2.4%), while San Miguel County had the smallest (1.1%). All counties are projected to increase in population size over the next 20 years. By 2023, the ROI population is projected to be more than 250,000, a 29% increase from the 2010 census.

Population growth rates between 2000 and 2010 were highest for some of the ROI's largest cities, including Fruita (6.9%), Grand Junction (3.4%), and Montrose (4.5%) (Table 3.8-6). Fruita experienced the highest rate of population growth (6.9%), almost doubling its population in the 10 years between 2000 and 2010. The town of Sawpit was the only town to experience a negative growth rate (–0.8%), although because of its small population size, the impact on the ROI was negligible. Six towns experienced a growth rate of less than 1% (Orchard Mesa, Redlands, Naturita, Nucla, Norwood, and Telluride), and six towns experienced a growth rate between 1% and 2% (Clifton, Collbran, Fruitvale, Palisade, Olathe, and Ophir). Four towns grew at a rate that was more than 2% (Fruita, Grand Junction, Montrose and Mountain Valley). Of these, only the town of Mountain Village had a population of fewer than 6,000 people. The populations of two of the three largest cities in the ROI (Grand Junction and Montrose) increased fairly rapidly at a rate of more than 3.4%. The second-largest city, Clifton, had a population growth rate of 1.4%. Overall, relatively high growth rates in the larger towns contributed to the moderate population growth in the ROI as a whole.

3.8.2.2 ROI Housing

On average, vacant housing in the ROI increased from 8.8% in 2000 to 10.0% in 2009 (Table 3.8-7). The ROI had a total of 8,117 total vacant units. As would be expected, Mesa County contained the most housing units, with a total of 58,329 units. Mesa County and Montrose County have similar rates of housing vacancy; in 2009, Mesa County had 6% of its available housing vacant, and Montrose County had a vacancy rate of 8.9%. San Miguel County, however, had the highest vacancy rate by far, at 50%. Many residential units in San Miguel County are used as vacation accommodations or second homes rather than for primary housing. Available units are generally priced too high, and it is estimated that 44% of the households in San Miguel County are living in houses that are not affordable (RRC Associates and Rees Consulting 2011). On the other hand, vacancy rates for rental units are very low; in Telluride, where seasonal housing is in demand, the vacancy rate is only 1.1%. This suggests that most of the vacancy stems from high sale prices, because even though there is a demand for affordable housing, the vacancy rate remains high (RRC Associates and Rees Consulting 2011).

TABLE 3.8-6 ROI Urban Population and Income, 1999–2010

	Population			Median Household Income ($ 2010)		
City in Colorado	2000	2010	Average Annual Growth Rate, 2000–2010 (%)	1999	2005–2009	Average Annual Growth Rate, 2005–2009 (%)[a]
Clifton	17,345	19,899	1.4	44,174	43,073	–0.25
Collbran[b]	389	439	1.2	42,538	43,985	0.34
De Beque[b]	474	543	1.4	38,784	59,431	4.36
Fruitvale	6,936	7,675	1.0	58,163	56,732	–0.25
Fruita	6,478	12,646	6.9	43,099	56,815	2.80
Grand Junction	41,986	58,566	3.4	43,391	46,460	0.69
Orchard Mesa	6,456	6,836	0.6	53,513	51,465	–0.39
Palisade[b]	2,585	2,931	1.3	36,306	44,600	2.08
Redlands	8,043	8,685	0.8	70,067	67,490	–0.37
Montrose	12,344	19,132	4.5	44,174	45,497	0.30
Naturita[b]	637	669	0.5	29,777	29,452	–0.11
Nucla[b]	736	744	0.1	37,258	49,761	2.94
Olathe[b]	1,601	1,764	1.0	34,405	32,035	–0.71
Mountain Village[b]	991	1,389	3.4	40,134	35,447	–1.23
Norwood[b]	438	460	0.5	51,536	38,702	–2.82
Ophir[b]	113	128	1.3	75,805	52,345	–3.64
Sawpit[b]	25	23	–0.8	34,358	91,222	10.26
Telluride[b]	2,254	2,400	0.6	67,980	68,970	0.14

[a] Data are averages for the period 2005 to 2009.

[b] Data are for 2009 population estimates.

Sources: U.S. Bureau of the Census (2011b,c,d,e)

3.8.2.3 ROI Community and Social Services

The following sections discuss community and social services, including levels of service, in the ROI. The jurisdictions included in the ROI are listed in Table 3.8-8.

3.8.2.3.1 Education. There were a total of 68 schools located within the ROI in 2010. As shown in Table 3.8-9, there was an average student/teacher ratio of 16.7, which was comparable to the state average of 16.9, but somewhat higher than the nationwide average of 15.4. Mesa County had the highest student-teacher ratio at 17 students per teacher, while San Miguel County had the lowest at 11.3. The levels of service (the number of employees per 1,000 population) ranged from 9.12 in Mesa County to 11.67 in San Miguel County. The overall level of service for the ROI was 9.39. The City of Grand Junction contained the largest number of schools in the ROI by far; Mesa County School District 51 has 44 public schools (elementary, middle, high,

TABLE 3.8-7 ROI Housing Characteristics, 2000 and 2009

Status of Housing	No. of Units 2000	No. of Units 2009[a]
Mesa County		
Owner-occupied	33,313	39,539
Rental	12,510	15,272
Vacant units	2,604	3,518
Percentage vacancy	5.4	6.0
Seasonal and recreational use	508	NA[b]
Total units	48,427	58,329
Montrose County		
Owner-occupied	9,773	11,875
Rental	3,270	3,765
Vacant units	1,159	1,521
Percentage vacancy	8.2	8.9
Seasonal and recreational use	194	NA
Total units	14,202	17,161
San Miguel County		
Owner-occupied	1,556	1,894
Rental	1,459	1,159
Vacant units	2,182	3,078
Percentage vacancy	42	50.2
Seasonal and recreational use	1,741	NA
Total units	5,197	6,131
ROI total		
Owner-occupied	44,642	53,308
Rental	17,239	20,196
Vacant units	5,945	8,117
Percentage vacancy	8.8	9.9
Seasonal and recreational use	2,443	NA
Total units	67,826	81,621

[a] 2009 data for number of owner-occupied, rental, and vacant units for Colorado counties are not available; data are based on 2009 total housing units and 2000 data on housing tenure.

[b] NA = data not available.

Source: U.S. Bureau of the Census (2011f)

TABLE 3.8-8 ROI Jurisdictions

Type of Jurisdiction	Governments
Counties	Mesa, Montrose, San Miguel
Cities	Clifton, Collbran, De Beque, Fruitvale, Fruita, Grand Junction, Orchard Mesa, Palisade, Redlands, Montrose, Naturita, Nucla, Olathe, Mountain Village, Norwood, Ophir, Sawpit, Telluride
School districts	De Beque, Joint District No. 49, Grand Valley Boces, Mesa 51 Grand Junction, Mesa County Valley School District No. 51, Plateau Valley, School District No. 50 In The County Of Mesa, Montrose County School District Re-1j, Montrose Re-1j, West End School District No. Re-2, Norwood School District No. R-2j, Telluride School District No. R-1
Tribal	Jicarilla Apache Nation, New Mexico

Sources: NCES (2011); U.S. Bureau of the Census (2011d); DOI (2011)

TABLE 3.8-9 ROI School District Data, 2010[a]

Location	Number of Students	Number of Teachers	Student-Teacher Ratio	Level of Service
Mesa County	22,699	1,338	17	9.12
Montrose County	6,867	410	16.8	9.93
San Miguel County	973	86	11.3	11.67
ROI	30,539	1,834	16.7	9.39

[a] Number of teachers per 1,000 population.

Source: NCES (2011)

and alternative) within the greater metropolitan area, serving over 22,000 students. Mountain Village, Ophir, and Sawpit are towns in the ROI that do not contain any schools; students from there attend schools in Telluride. Although the student-teacher ratio for each county is comparable to the state average, it varies among towns. For instance, Grand Junction has the highest ratio, but smaller towns, such as Collbran, Telluride, De Beque, and Norwood, have an average of 11.46 students per teacher (NCES 2011).

Colorado Mesa University in Grand Junction is a public university that offers associate's, bachelor's, and master's degrees; it is the only college or university in the ROI. Until April 2011, the school was known as Mesa State College. The school has an enrollment of 9,000 students. Western Colorado Community College, a division of Colorado Mesa University, offers degree programs focused on technical training, including construction technology, machining technology, transportation technology, and welding services, among other technical and nontechnical degree programs.

3.8.2.3.2 Health Care. The number of physicians and the level of service are two measures for determining access to adequate healthcare. In 2010, most of the physicians in the ROI were located in Mesa County (552) (Table 3.8-10). The level of service was the lowest in San Miguel County, which also had the fewest number of physicians (19). The level of service was highest in Mesa County (3.76), and it was 3.51 for the entire ROI. Mesa County has three hospitals, all in Grand Junction: Community Hospital (78 beds); St. Mary's Hospital (350 beds, and the largest medical center between Denver and Salt Lake City); and the Grand Junction Veterans Administration Medical Center (53 beds). Montrose County has one hospital, Montrose Memorial Hospital; it has 75 beds and is located in the city of Montrose. There are also clinics in Olathe and Naturita. The Telluride Medical Center, with 7 beds, is the only hospital in San Miguel County.

3.8.2.3.3 Public Safety. As shown in Table 3.8-11, in 2009, most of the firefighters in the ROI were located in Mesa County. The level of service was the lowest in San Miguel County (0.40), which also had the fewest number of professional firefighters. The level of service was highest in Mesa County (0.60), and it was 0.57 for the entire ROI.

Most of the police officers in the ROI were also located in Mesa County (122).The level of service was highest in San Miguel County (4.37), which also had the fewest number of police officers (33). The level of service was lowest in Mesa County (0.84), and it was 1.08 for the entire ROI. The highest crime rates for both violent crimes and property crimes were also in the most populated county, Mesa County, which also had the lowest level of service with regard to police officers (Table 3.8-12). The incidences of crime in Montrose and San Miguel Counties were comparable to one another, although more property crime occurred in San Miguel County.

TABLE 3.8-10 ROI Physicians, 2010[a]

Location	No. of Physicians	Level of Service
Mesa County	552	3.76
Montrose County	115	2.79
San Miguel County	19	2.58
ROI	686	3.51

[a] Number of physicians per 1,000 population.

Source: AMA (2010)

TABLE 3.8-11 ROI Public Safety Employment, 2009

Location	No. of Police Officers	Level of Service[a]	No. of Firefighters[b]	Level of Service
Mesa County	122	0.84	88	0.60
Montrose County	56	1.35	21	0.51
San Miguel County	33	4.37	3	0.40
ROI	211	1.08	112	0.57

[a] Number per 1,000 population.

[b] Number does not include volunteers.

Sources: DOJ (2009b); Fire Departments Network (2011)

TABLE 3.8-12 ROI and County Crime Rates, 2009[a]

	Violent Crime[b]		Property Crime[c]		All Crime	
Location	No. of Offenses	Rate	No. of Offenses	Rate	No. of Offenses	Rate
Mesa County	185	1.3	1,467	10.0	1,652	11.3
Montrose County	36	0.9	136	3.3	172	4.2
San Miguel County	3	0.4	36	4.9	39	5.3
ROI	224	1.15	1,639	8.39	1,863	9.54
Colorado	21,179	0.45	177,629	3.77	198,808	4.2

[a] Rates are the number of crimes per 1,000 population.

[b] Violent crime includes murder and non-negligent manslaughter, forcible rape, robbery, and aggravated assault.

[c] Property crime includes burglary, larceny, theft, motor vehicle theft, and arson.

Source: DOJ (2009a)

The rates of crime for the ROI were higher than those in the state of Colorado for both property crimes and violent crimes.

3.8.3 Recreation and Tourism Economy

Western Colorado is a major tourist destination. Visitors travel to western Colorado year-round for outdoor sports, including hiking, biking, whitewater rafting, horseback riding, skiing, OHV trail-riding, hunting, fishing, and snowshoeing. Most of the land in the ROI is managed by the USFS and BLM. The BLM manages more than 8.4 million acres (3.4 ha) in Colorado and provides recreation opportunities for more than 5 million visitors annually. Much of the public land in the ROI is accessible for public recreational use. Among the many recreation areas that the BLM manages are numerous SRMAs and NLCS units (BLM undated). SRMAs are areas where recreation is the principal management focus and where the objective is to provide specific “structured” recreational opportunities (BLM 2011k). These can include campgrounds, trails, and boat ramps for river access. The Dolores Canyon SRMA in Montrose County is in close proximity to the lease tracts. The distance from the SRMA to the lease tracts ranges from 0.48 mi (0.77 km) (Lease Tract 17) to 8.4 mi (14 km) (Lease Tract 19). In San Miguel County, three of the leases are located within the SRMA. The Dolores Canyon SRMA is a popular location for whitewater rafting and river sports, and its visitors are attracted to the Dolores River’s remote character. Developed recreation sites are located along the San Miguel River SRMA and in the Dolores River SRMA. There are several developed campsites along the San Miguel River corridor that have boat ramps and other amenities such as toilets, picnic areas, and parking areas (BLM 2012a). In addition, the Unaweep-Tabeguache Scenic and Historic Byway is 133 mi (214 km) along CO 141 and 145 and passes through the towns of Nucla, Naturita, Uravan, Redvale, and Norwood. The scenic byway follows the Dolores and San Miguel Rivers and offers recreational opportunities on backroads and trails on BLM and USFS land, as well as whitewater rafting and kayaking (CCCD 1995). There are a variety of unimproved roads on and around the lease tracts, many of which were constructed by the mining and ranching industries and are currently maintained by county agencies or the BLM (see Section 3.10 for additional information on transportation and roads).

As discussed in Section 3.8.2.1.2, employment in the ROI is concentrated in the service industry, and much of that results from the recreation provided by the publicly managed areas discussed above. The tourism industry is difficult to quantify; it covers multiple job sectors and has direct and indirect impacts on the local economy resulting from increased sales from visitor spending, changes to local employment and income, and induced effects reflected in local goods and services purchased by residents who experience changes in income from new economic activity.

In September 2001, the Southwest Colorado Travel Region (SWCTR) and the USFS sought to understand the relationship between tourism and employment in the region, including the regional dependency on tourism, the types of jobs that tourism supports, ways to encourage growth in employment, ways to develop complementary economic industries (e.g., real estate and construction), and the connections between the tourism industry and local government services and revenues. The SWCTR comprises 12 counties, including Montrose and San Miguel

Counties. The study aimed to identify the types of tourism that drive the local economy. A distinction was made between activities that took place on public lands and those that occurred on private lands. This distinction helped to clarify the difference between the impacts from public parks and outdoor recreation and the impacts from private resort recreation (Information Services 2001).

In 2000, the tourism industry accounted for 14% of the jobs and 9% of the income generated in Montrose County. In San Miguel County, the percentages of tourism-related jobs and income were 59% and 53%, respectively. Total wages from tourism employment totaled $27 million in Montrose County and more than $80 million in San Miguel County. Employment in the tourism industry related to public lands represented 7% of all employment in Montrose County, 38% in San Miguel County, and 14% in the SWCTR region. Activities on public lands include skiing and touring, visits to parks and monuments, and outdoor recreation. Outdoor recreation includes hiking, biking, fishing, hunting, rafting, and snowmobiling on public land. In Montrose County, outdoor activities were responsible for the most tourism-related employment in 2000, mostly in the summer and fall months. In San Miguel County, the real estate and construction sector was very strong, although the ski resort in Telluride provided the largest number of jobs in the tourism sector. From 1997 to 1999, tourism employment in San Miguel County grew 14% (Information Services 2001). In 2010, 63% of employment in San Miguel County came from the tourism industry, an increase of 4% since 2000 (Colorado Department of Local Affairs 2011).

Public land use and activity estimates are difficult to quantify accurately and depend on a combination of computerized trail counter data, field observations, and the professional judgment of the recreation staff (BLM 2012i). The general trend across the Grand Junction Field Office has been a 7–10 percent increase in visitation each year. Black Canyon of the Gunnison National Park is located in the eastern portion of Montrose County, 52 mi (84 km) east of the nearest lease tract. In 2010, 176,344 people visited the national park, which was fewer than the number of visitors in 2000 (191,500) and 2007 (219,600) (www.nationalparked.net 2011). A 2010 visitor survey conducted at Black Canyon National Park indicated that out-of-state visitors accounted for more than 65% of those surveyed, which suggests that park visitors probably also spent money outside the park in other sectors, such as for hotel and other accommodations and in eating and drinking establishments.

The Colorado National Monument is located 25 mi (40 km) north of the nearest lease tracts in Mesa County. Other recreation areas in Mesa County include Bangs Canyon SRMA, Grand Mesa Slopes SRMA, and the James M. Robb Colorado River State Park. Visitation to Colorado National Monument increased over the past few years, achieving a record-high number of annual visitors of 714,000 in 2007, a 9% increase from the previous year (National Park Service 2008). Hiking use increased 34% in October 2007 compared to that in October 2006, and the park experienced increases in other types of recreation, including biking and rock climbing. An economic analysis of state parks in Colorado estimated that the average vehicle visiting Colorado River State Park spent $312 within 50 mi (80 km) of the park. Total expenditures for all visitors to the park totaled almost $23 million (Corona Research, Inc. 2009).

3.9 ENVIRONMENTAL JUSTICE

On February 11, 1994, the President signed E.O. 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," which formally requires Federal agencies to incorporate environmental justice as part of their missions (59 FR 7629, Feb. 11, 1994). Specifically, it directs them to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

The analysis of how mining projects affect environmental justice concerns follows guidelines described in the CEQ's *Environmental Justice Guidance under the National Environmental Policy Act* (CEQ 1997). The analysis method has three parts. First, a description of the geographic distribution of low-income and minority populations in the affected area is undertaken. Then an assessment is conducted to determine whether exploration, mine development and operations, and reclamation would produce human health or environmental impacts that are high and adverse. Finally, if impacts are high and adverse, a determination is made as to whether these impacts disproportionately affect minority and low-income populations.

Exploration, mine development and operations, and reclamation in the proposed lease tracts could affect environmental justice if any adverse human health and environmental impacts resulting from any phase would be significantly high and if these impacts would disproportionately affect minority and low-income populations. If the analysis determined that human health and environmental impacts would not be significant, there could be no disproportionately high and adverse impacts on minority and low-income populations. In the event a potential for human health or environmental impacts is significant, disproportionality would be determined by comparing the proximity of any high and adverse impacts with the location of low-income and minority populations. For example, the analysis would consider whether potentially significant human health risks would appreciably exceed the risk to the general population.

The analysis of environmental justice issues associated with the development of uranium facilities considered impacts within the proposed lease tracts and an associated 50-mi (80-km) radius around the boundary of the proposed lease tracts. A description of the geographic distribution of minority and low-income groups in the affected area was based on Census Bureau demographic data (U.S. Bureau of the Census 2011g,h). The following definitions were used to define minority and low-income population groups:

- *Minority*. Persons are included in the minority category if they identify themselves as belonging to any of the following racial groups: (1) Hispanic; (2) Black (not of Hispanic origin) or African American; (3) American Indian or Alaska Native; (4) Asian; or (5) Native Hawaiian or Other Pacific Islander.

  Beginning with the 2010 census, where appropriate, the census form allows individuals to designate multiple population group categories to reflect their ethnic or racial origin. In addition, persons who classify themselves as being of multiple racial origins may choose up to six racial groups as the basis of their racial origins. The term minority includes all persons, including those classifying themselves in multiple racial categories, except those who classify themselves as not being of Hispanic origin and as being White or "Other Race" (U.S. Bureau of the Census 2011g).

The CEQ guidance proposed that minority populations should be identified where either (1) the minority population of the affected area exceeds 50% or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

The ULP PEIS applies both criteria in using the Census Bureau data for census block groups, wherein consideration is given to the minority population that is both greater than 50% and 20 percentage points higher than in the state (the reference geographic unit).

- *Low-income.* Individuals who fall below the poverty line. The poverty line takes into account the family size and the ages of individuals in the family. For example, in 2009, the poverty line for a family of five with three children younger than 18 was $26,023. For any given family below the poverty line, all family members are considered as being below the poverty line for the purposes of analysis (U.S. Bureau of the Census 2011h).

The data in Table 3.9-1 show the minority and low-income composition of the total population located in the proposed lease tracts based on Census Bureau data and CEQ guidelines. Individuals identifying themselves as Hispanic or Latino are included in the table as a separate entry. However, because Hispanics can be of any race, this number also includes individuals who also identify themselves as being part of one or more of the population groups listed in the table.

Within the 50-mi (80-km) radius around the boundary of the proposed lease tracts in Colorado, 18.3% of the population is classified as minority, while 11.9% is classified as low-income. Because the number of minority individuals does not exceed 50% of the total population in the 50-mi (80-km) area and because the number of minority individuals does not exceed the state average by 20 percentage points or more, there is no minority population in the Colorado portion of the proposed lease tracts based on Census Bureau data and CEQ guidelines. The number of low-income individuals does not exceed the state average by 20 percentage points or more and does not exceed 50% of the total population in the area; therefore, there are no low-income populations in the Colorado portion of the proposed lease tracts.

Within the 50-mi (80-km) radius in Utah, 25.9% of the population is classified as minority, while 16.1% is classified as low-income. Because the number of minority individuals does not exceed the state average by 20 percentage points or more and because the number of minority individuals does not exceed 50% of the total population in the area, there is no minority population in the Utah portion of the 50-mi (80-km) area based on Census Bureau data and CEQ

TABLE 3.9-1 Minority and Low-Income Populations within the 50-mi (80-km) Radius Surrounding the Proposed Lease Tracts

Type of Population	Colorado	Utah
Total population	245,460	22,727
White, non-Hispanic	200,585	16,837
Hispanic or Latino	34,682	1,575
Non-Hispanic or Latino minorities	210,778	21,152
One race	207,210	20,826
Black or African American	1,056	49
American Indian or Alaskan Native	3,544	3,789
Asian	1,578	129
Native Hawaiian or other Pacific Islander	202	11
Some other race	245	11
Two or more races	3,568	326
Total minority	44,875	5,890
Low-income	11,184	1,164
Percentage minority	18.3	25.9
State percentage minority	30.0	19.6
Percentage low-income	11.9	16.1
State percentage low-income	12.2	10.8

Sources: U.S. Bureau of the Census (2011g,h)

guidelines. The number of low-income individuals does not exceed the state average by 20 percentage points or more and does not exceed 50% of the total population in the area; therefore, there are no low-income populations in the Utah portion of the proposed lease tracts.

Figures 3.9-1 and 3.9-2 show the locations of the minority and low-income population groups within the 50-mi (80-km) radius around the boundary of the proposed lease tracts.

In the Colorado portion of the 50-mi (80-km) radius, there are single block groups in the cities of Grand Junction, Montrose, and Olathe that are more than 50% minority. One block group in southwestern Montezuma County is also more than 50% minority; it is the location of the Ute Mountain Indian Reservation. In the Utah portion of the 50-mi (80-km) radius, San Juan County has two block groups (one located in the southeastern part of the county, and the other in the central and southwestern part of the county) that are more than 50% minority. There are no block groups in the Utah portion of the 50-mi (80-km) radius that have minority populations that are 20 percentage points higher than the state average but less than 50% minority.

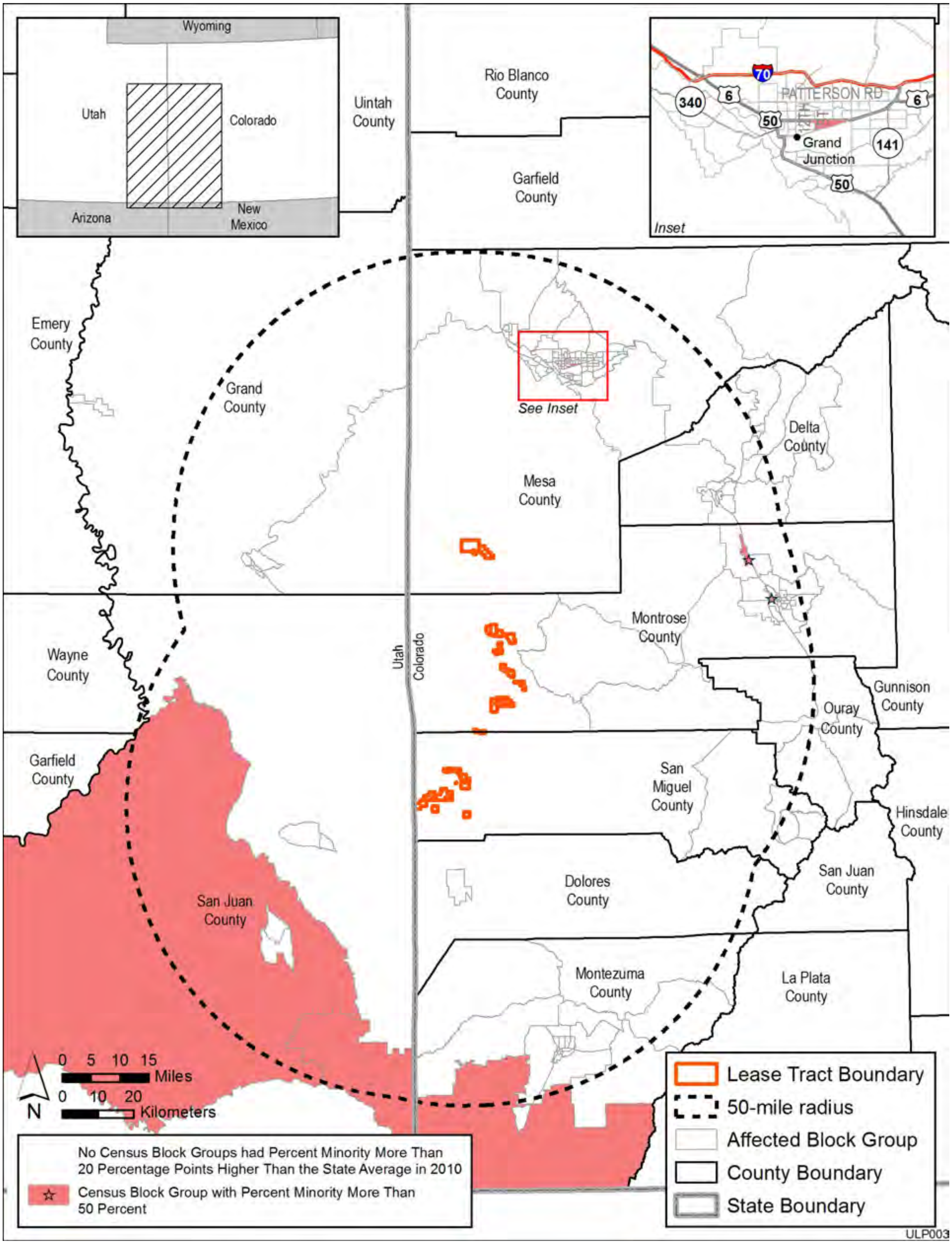


FIGURE 3.9-1 Minority Populations within the 50-mi (80-km) Radius surrounding the Proposed Lease Tracts

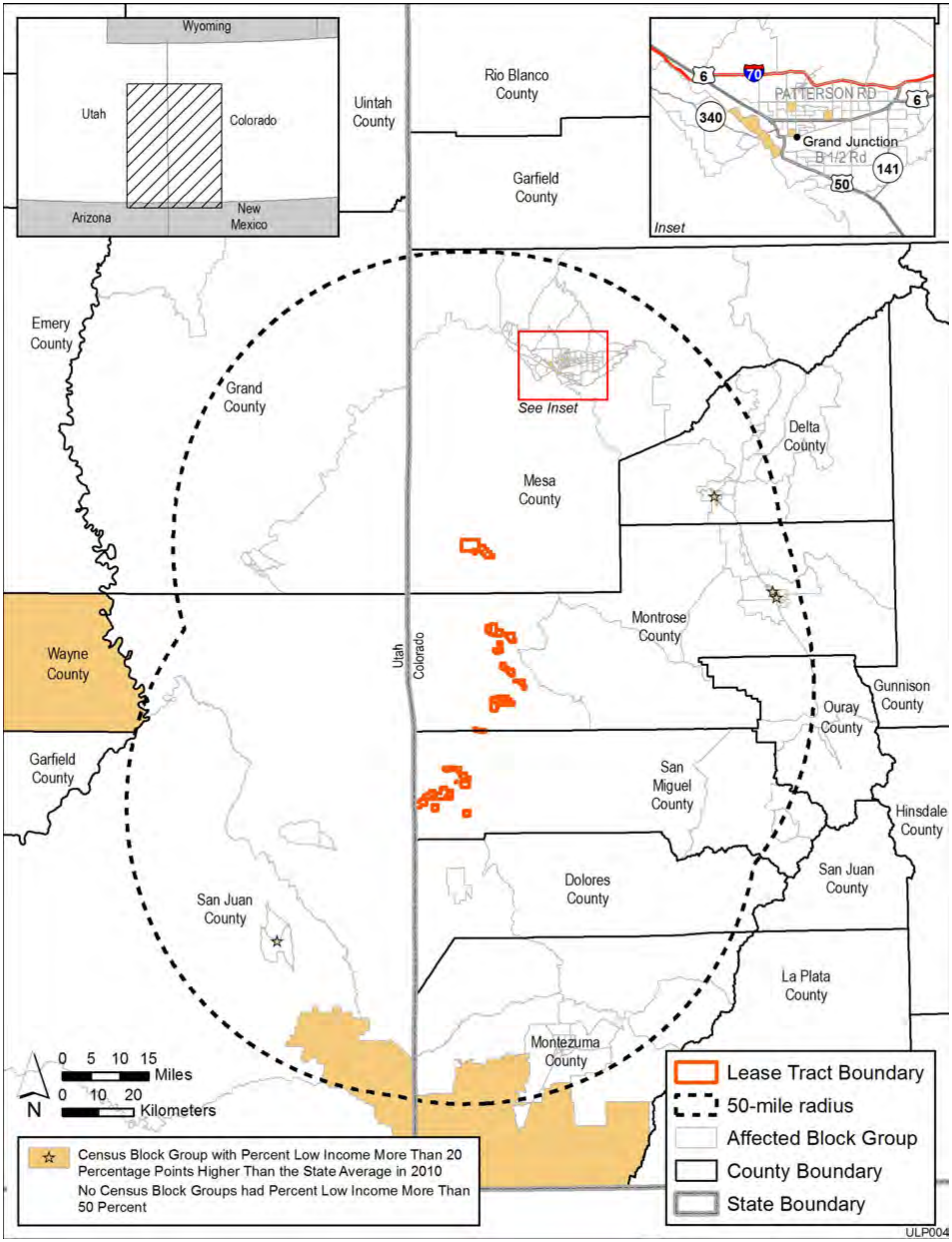


FIGURE 3.9-2 Low-Income Populations within the 50-mi (80-km) Radius surrounding the Proposed Lease Tracts

In the Colorado portion of the 50-mi (80-km) radius, the number of low-income individuals is more than 20 percentage points higher than the state average in four block groups in the city of Grand Junction, in two block groups in Montrose, and in one block group in Delta. There is also a single block group in southwestern Montezuma County, in the Ute Mountain Indian Reservation. In the Utah portion of the 50-mi (80-km) radius, there are block groups in the southeastern part of San Juan County, and in the city of Blanding, that have low-income population shares that are more than 20 percentage points higher than the state average. There are no block groups in either portion of the 50-mi (80-km) radius where the population is more than 50% low income.

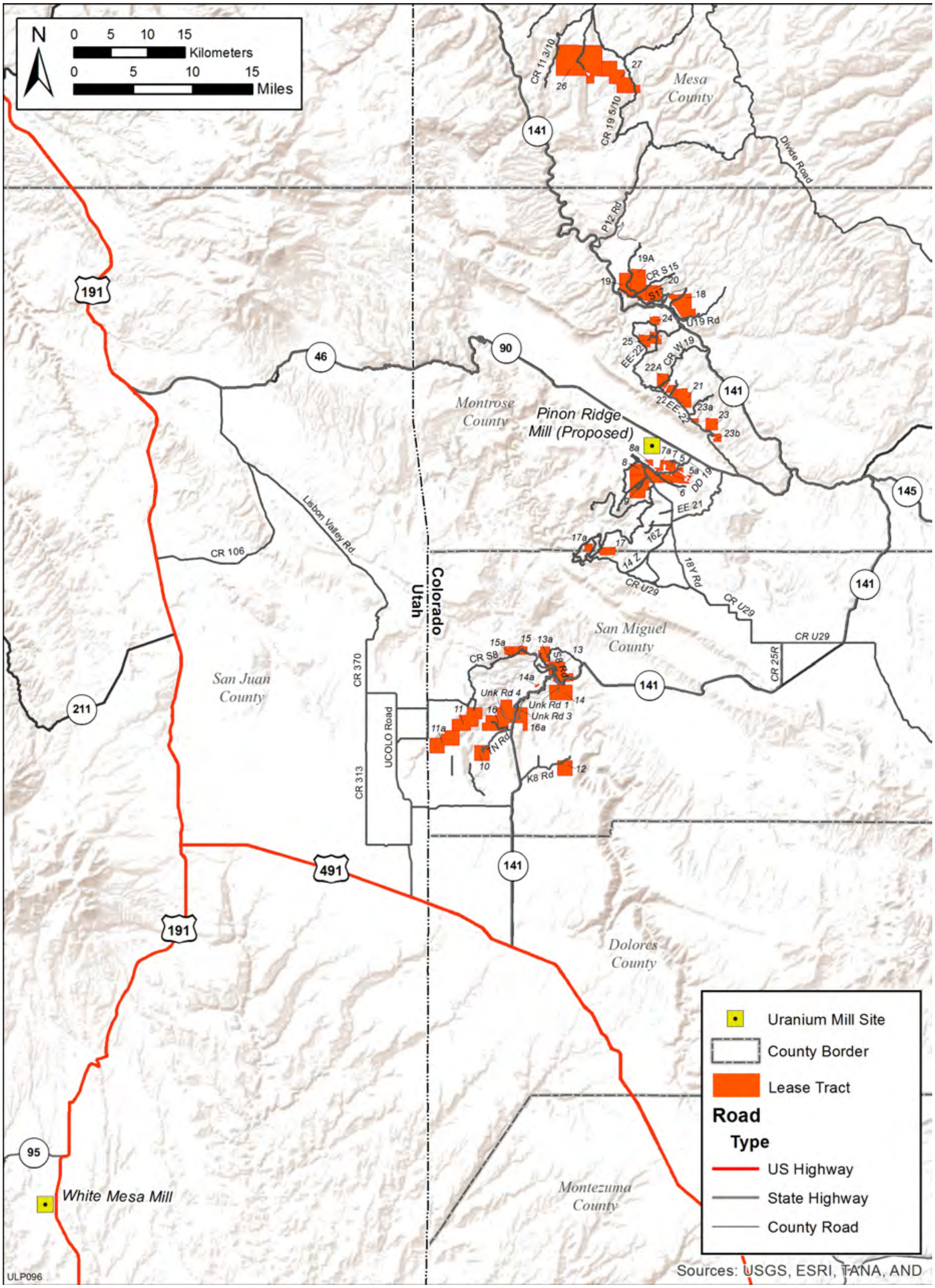
3.10 TRANSPORTATION

The road network in western Colorado in the area of the lease tracts and the proposed Piñon Ridge Mill consists of two primary roads, State Highways CO 90 and CO 141, as shown in Figure 3.10-1. A number of county roads provide access to the lease tracts from these highways, as shown in Figures 3.10-2 to 3.10-4. A variety of unimproved roads on public lands exist on and around the lease tracts. Many of these roads were constructed by the mining and ranching industries before the BLM developed regulations for authorizing road construction and use. However, many of these roads are currently maintained by county agencies or the BLM.

Travel on BLM land is currently limited to existing routes. However, as per BLM's planning handbook guidance, the "Limited to Existing Routes" designation will be changed to "Limited to Designated Routes" no later than 5 years after the signing of the Resource Management Plan revision ROD. The use of motorized or mechanized modes of travel (including snowmobiles) during the execution of BLM-issued authorizations or permits would be subject to the terms and conditions or stipulations of each individual authorization on a case-by-case basis. Additional environmental documentation and analysis could be required for some authorizations (BLM2008-64 EA and Land Use Plan Amendment).

Although most of the area roads pass through uninhabited public lands, 15 residences among the 31 lease tracts could be affected by ore shipments travelling on these haul roads en route to the state highways and subsequently to the ore-processing mills. Routes that pass 13 of the 15 residences have been used in the last 10 years to haul uranium ore, and all the routes have been used to haul ore in the last 30 years.

The White Mesa Mill in Utah south of Blanding is served by US 191. Access to the mill from the lease tracts would be via CO 141 south to US 491 at Dove Creek, then west to US 191. An alternate route from the general lease tract would be to take CO 90 west into Utah where it becomes UT 46, which continues westward to US 191. The annual average traffic volume on major roads near the lease tracts each day is listed in Table 3.10-1.

1 

2 **FIGURE 3.10-1 Road Network by the Lease Tracts and Uranium Mills**

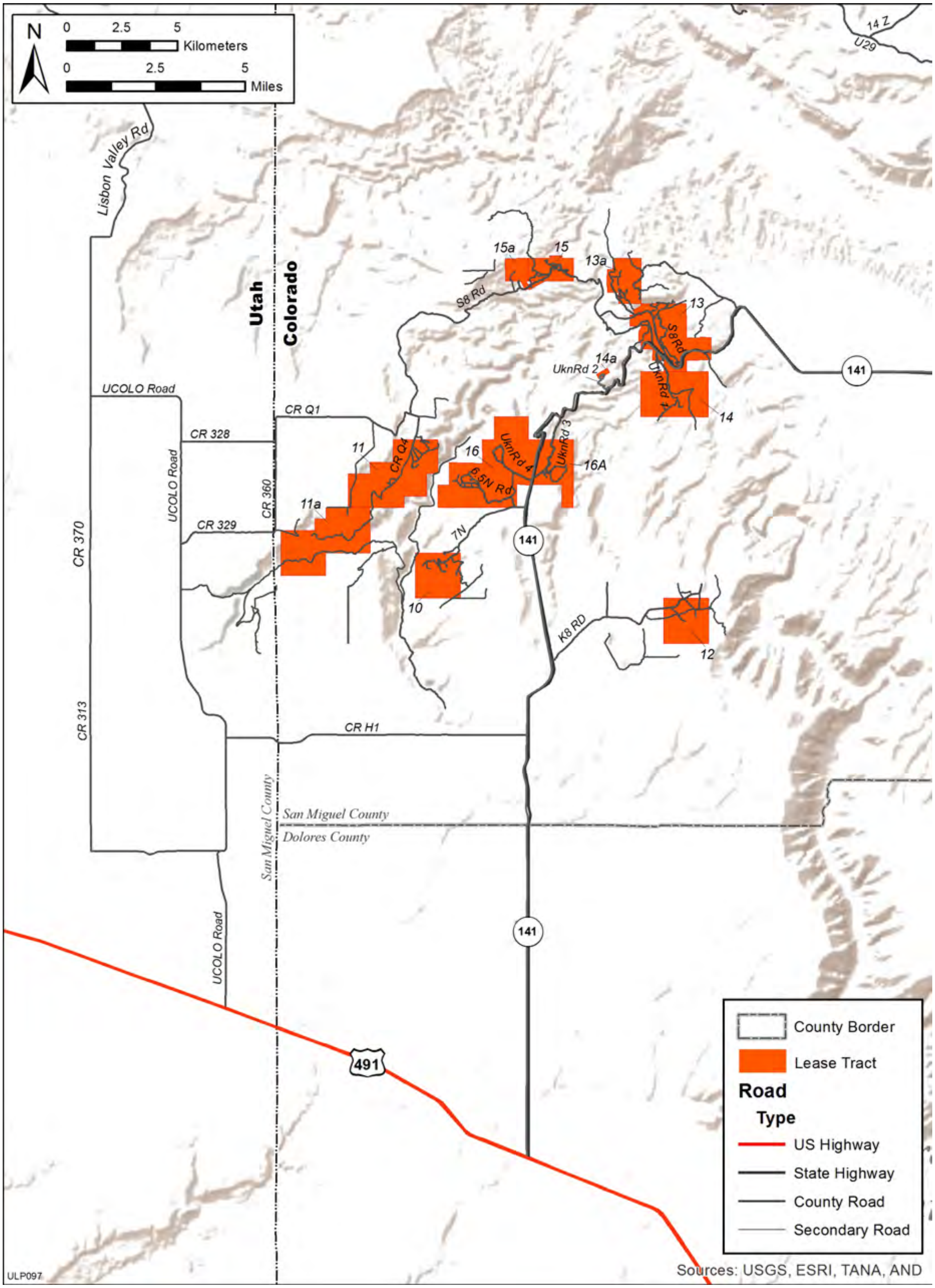


FIGURE 3.10-2 Local Road Network around the Slick Rock Lease Tracts

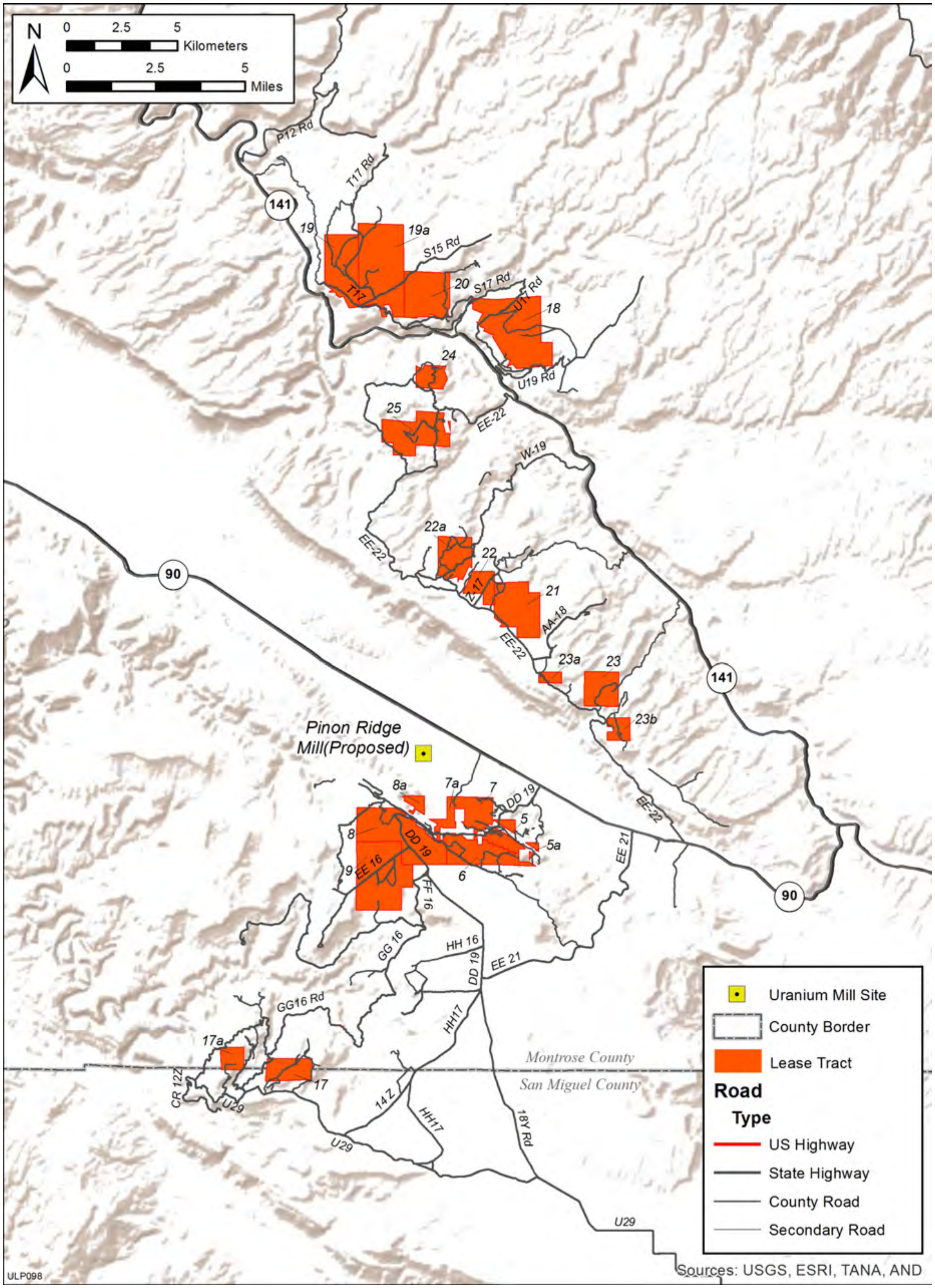


FIGURE 3.10-3 Local Road Network around the Paradox and Uravan Lease Tracts

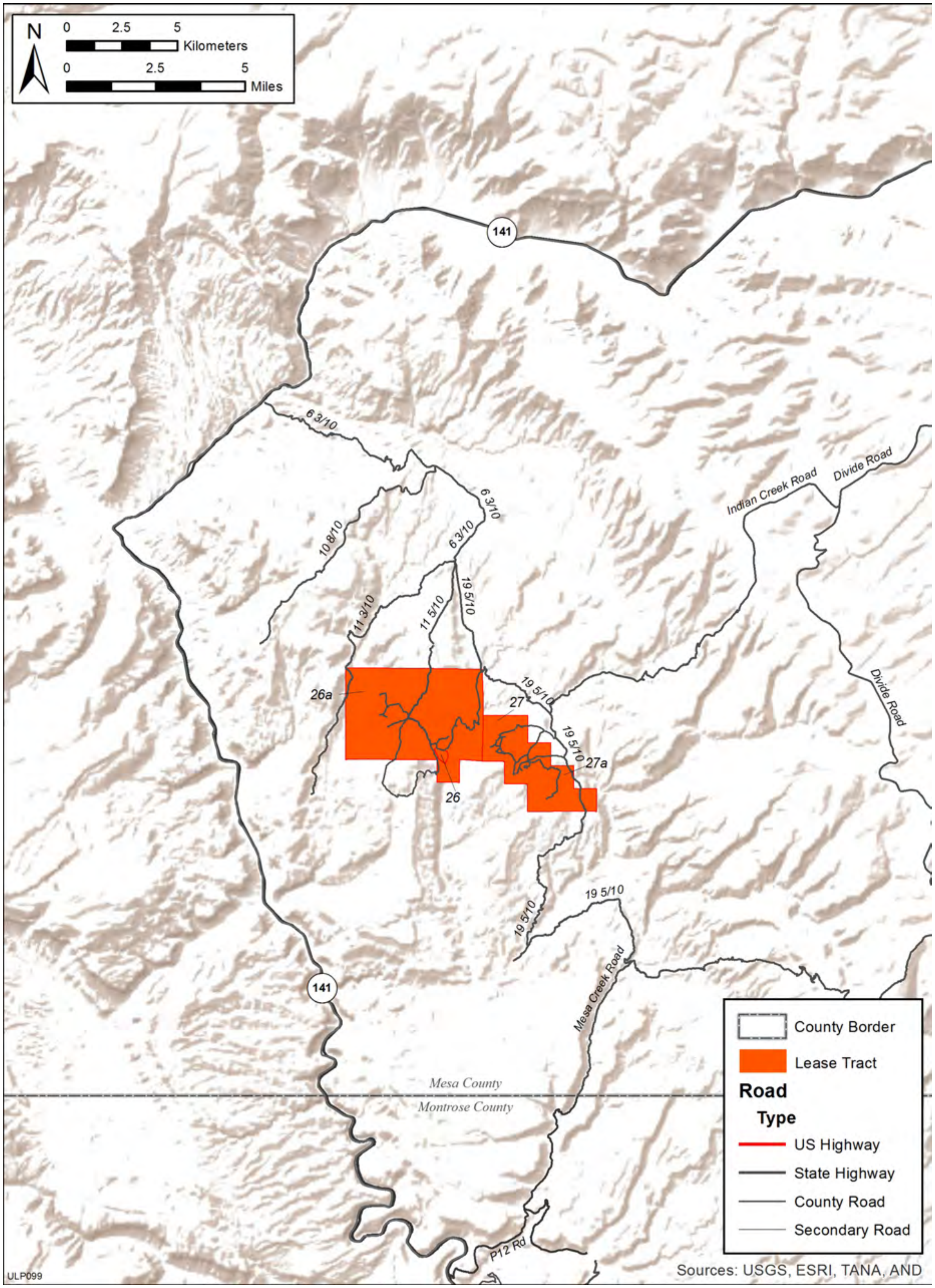


FIGURE 3.10-4 Local Road Network around the Gateway Lease Tracts

TABLE 3.10-1 Annual Average Daily Traffic (AADT) Volumes for Major Roads near the Lease Tracts, 2010

	Mileage Marker			AADT	
Road	Start	End	Location[a]	All	Trucks
***Colorado*[b]**					
CO 90	0	9.5	UT/CO state line east toward Paradox	230	30
	9.5	14.8	Near Bedrock	330	40
	14.8	33.9	Near western junction with CO 141	430	40
	81.7	84.9	East of Shavano Valley Road intersection, western outskirts of Montrose	190	10
CO 141	0	9.4	North of intersection with US 491	590	20
	9.4	11.3	North of Monticello Rd./CR H1 intersection in Egnar	350	50
	11.3	44.1	North of Egnar, southeast of K8 Rd.	250	40
	44.1	55.5	Southeast of junction with CO 145	470	70
	55.5	60.2	Northwest of junction with CO 145	1,300	130
	60.5	60.7	Main St. in Naturita, west of CO 97 (Nucla Rd.)	2,100	110
	60.8	62.4	East of junction with CO 90	600	70
	62.4	64.4	West of junction with CO 90	270	30
	64.4	110.5	Southwest of John Brown Rd. (4 4/10 Rd.) in Gateway	280	30
	110.5	153.8	Northeast of junction with CR Sx 9/10 Rd. in Gateway	660	80
	153.8	154.1	Southwest of junction with CO 50 in Whitewater	1,100	90
US 491	68.7	69.6	At UT/CO state line	2,100	460
	63.3	67.9	Northwest of CO 141	2,300	440
	61.5	63.3	Southeast of CO 141	3,100	550
***Utah*[c]**					
US 191	36.4	47.3	Junction with CO 262	2,525	270
	47.3	50.4	Junction with CO 95, south of Blanding	2,820	340
	50.4	51.7	Blanding, 800 south	5,025	655
	51.7	65.2	Blanding, 200 north	2,970	385
	65.2	71.5	Verdure	2,490	350
	71.5	71.9	Monticello, 400 south	2,670	615
	71.9	72.4	Monticello, junction with US 491	5,965	1,610
	72.4	86.1	Monticello, 600 north	3,575	1,145
US 491	0.0	0.4	Monticello, junction with US 191	4,620	970
	0.4	2.0	Monticello, 500 east	2,430	630
	2.0	17.0	Monticello Port of Entry at Milepost 2 to UT/CO state line	2,270	770

[a] CR = County Road

[b] Source: CDOT (2011)

[c] Source: UDOT (2011)

3.11 CULTURAL RESOURCES

Cultural resources are resources important to maintaining the heritage of the people of the United States. They provide a physical connection to the past and contemporary traditional culture. They include archaeological sites; historic buildings and structures or groups of structures; landscapes; culturally important natural features; and traditional cultural properties important to specific social or cultural groups, such as Native American Indian tribes. Cultural resources that meet the eligibility criteria for listing on the *National Register of Historic Places* (NRHP) (see text box) are termed "historic properties" under the National Historic Preservation Act of 1966, as amended (NHPA). The NHPA requires Federal agencies to take into account the potential effects of their undertakings, such as the leasing of uranium mining tracts, on designated and potential historic properties ranging in date from prehistoric times to the development of the Uravan Mineral Belt.

NRHP Significance Criteria

"The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association" and meet one or more of the following criteria for evaluation.

Criterion A: Associative Value – Event: "Properties can be eligible for the *National Register* if they are associated with events that have made a significant contribution to the broad patterns of our history."

Criterion B: Associative Value – Person: "Properties can be eligible for the *National Register* if they are associated with the lives of persons significant in our past."

Criterion C: Design or Construction Value: "Properties can be eligible for the *National Register* if they embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction."

Criterion D: Information Value: "Properties can be eligible for the *National Register* if they have yielded, or may be likely to yield information important to prehistory or history."

Also applicable is this special criteria consideration:

Criteria Consideration G: Properties That Have Achieved Significance within the Last Fifty Years. "A property achieving significance within the last fifty years is eligible if it is of exceptional significance."

(36 CFR 60.4)

3.11.1 Cultural History of Southwestern Colorado

Human presence in western Colorado appears to have begun during the Paleoindian era, although archaeological remains from that era are rarely encountered in the region. Four Paleoindian traditions have been distinguished based on projectile point styles. The earliest remains in western Colorado are part of the Clovis tradition, beginning about 13,400 years ago, sometimes found in association with mammoth or other Pleistocene megafauna. To date, no Clovis artifacts have been found in association with megafauna in the study area, but the distribution of Pleistocene megafauna finds and Clovis points elsewhere suggests that major canyons, well suited to megafauna at the end of the Pleistocene, were a likely focus of Clovis hunters (Reed 2006).

The Clovis tradition appears to have been followed by the Folsom tradition (12,800–11,500 years ago). Likewise focused on big game, Folsom hunters, using finely crafted, fluted lanceolate projectile points, appear to have preferred now-extinct species of bison. Folsom points are relatively rare in the study area, either because Folsom sites have been eroded or because the region was utilized less intensely at this time than in later periods. In the rugged and mountainous environs of southwestern Colorado, the Folsom tradition is followed by the Foothill-Mountain complex (11,500–7,500 years ago). Characterized by unfluted lanceolate points, the Foothill-Mountain complex reflects a broader subsistence base that included smaller game, such as deer, bighorn sheep, and pronghorn, and showed more regional variability than earlier Paleoindian cultures (Reed 2006).

The trend toward a broader subsistence base dependent on an increasingly wide array of smaller game and increased evidence of dependence on plant resources continued in the Archaic era. Milling stones, used in plant processing, increased in frequency, and projectile points, thought to be dart or lance points, were smaller and more variable, including corner- and side-notched varieties as well as certain varieties of stemmed points. Reed and Metcalf (1999) divided the Archaic era in west-central Colorado into four periods: Pioneer (7400–5400 B.C.); Settled (5400–3100 B.C.); Transitional (3100–1200 B.C.); and Terminal (1200–250 B.C.). These periods represent an increasing population and an increasing intensity of subsistence use. Archaic people appear to have followed a seasonal round, taking advantage of resources maturing at different times at different elevations. Winters appear to have been spent in the piñon-juniper woodlands of middle elevations in the winter range of deer and elk. Lower elevations may have been exploited in the spring, and higher elevations exploited in the summer and fall (Reed 2006).

The Archaic tradition was succeeded by the Formative stage (250 B.C.–A.D. 1300), which was marked by the introduction of maize horticulture, the introduction of the bow and arrow, the construction of more permanent dwellings, and the fabrication of ceramics. In southwestern Colorado, the integration of maize horticulture into subsistence strategies appears to have been incomplete. The growing season in the higher elevations of the project area was too short to support maize horticulture.

Sites representing the following four contemporaneous traditions associated with the Formative stage in western Colorado lie within or adjacent to the lease tracts (Reed 2006; Sullivan 2011).

1. The Anasazi or Ancestral Puebloan tradition—characterized by distinctive ceramics, highly patterned residential site layouts, pit structures, kivas, water control structures, and complex intraregional relations—is represented in areas near the southernmost Slick Rock lease tracts. It is likely that Ancestral Puebloan procurement forays from their northernmost settlements included the lease tracts. Social and environmental factors appear to have resulted in the abandonment of southwestern Colorado by Ancestral Puebloan peoples around 1275. Modern Puebloan groups regard the Ancestral Puebloan and Fremont as their ancestors.

2. The Fremont tradition, centered in Utah, may be minimally represented in the Paradox Valley of western Montrose County and in areas near the Gateway lease tracts. This tradition is represented by distinct coiled pottery, one-rod-and-bundle basketry, moccasins made from deer or mountain sheep hides, and artistic renditions of trapezoidal anthropomorphic figures. The Fremont appear to have abandoned the area about the same time as the Ancestral Puebloans for reasons that are not fully understood.

3. In western Montrose and San Miguel Counties, near the Paradox Valley and Uravan lease tracts, a third tradition, designated by Reed (2006) as the Gateway tradition, which reflected both Ancestral Puebloan and Fremont influence, has been recognized. It is characterized by limited reliance on maize horticulture; the manufacture of small arrow points; a lack of ceramic production; short-term use of noncontiguous, circular, masonry habitation structures, granaries, and storage cists constructed in rock shelters; and rock art that reflects both Ancestral Puebloan and Fremont influence. The Gateway tradition appears to be coterminous with maize horticulture. Gateway sites are clustered in western Montrose and San Miguel Counties near the central portion of the project area.

4. At this time, sites without masonry or evidence of horticulture are more common in west-central Colorado. These sites, often associated with the fourth, or Aspen, tradition, reflect a hunting and gathering lifestyle and are characterized by basin houses, tipi rings, and game drive systems. These sites may reflect a more intensive occupation exploiting areas with too short a growing season for maize, or they may be procurement sites for the Gateway population (Reed 2006).

While there is some debate as to when they first arrived in western Colorado (Fritz 2006), the Utes were the primary inhabitants of the project area between the end of the Formative era and their ultimate removal to present-day reservations in the late nineteenth century. The Utes were one of the Numic-speaking peoples centered in the Great Basin and the Colorado Plateau. Linguistic and archaeological evidence suggests that the Utes migrated from southwestern Nevada and southeastern California around A.D. 1100 (Ott et al. 2010). They were highly mobile hunters and gatherers, whose habitation structures were wickiups—brush structures with neither excavated floors nor post holes. They manufactured small amounts of brownware pottery, locally termed Uncompahgre brownware, and desert side-notched projectile points.

The period between 1100 and the beginning of an equestrian lifestyle in about 1650 is termed the Canalla phase. In this phase, the Utes followed a pedestrian hunting and gathering lifestyle following a seasonal round. During the following Antero phase (1650–1881), the acquisition of horses allowed the Utes to range farther onto the plains to hunt bison and to raid in the south and west, supplying slaves to Spanish immigrants. The Utes begin to take on aspects of Plains culture during this period, and Euro-American artifacts become increasingly more common at Ute sites.

The Spanish explorer Juan de Rivera led an expedition through the heart of the area in 1765 in search of mineral wealth. Later, in 1776, the Escalante-Dominguez party passed though western Colorado seeking a route from Santa Fe to California, which eventually led to the establishment of the northern branch of the Old Spanish Trail. The trail was followed by Spanish traders and by fur trappers and explorers. Euro-Americans began to explore the area's natural resources in the 1820s, when fur trappers such as James Pattie and Antoine Roubideau travelled through the area. The fur trade began to wane in the 1830s due to over-trapping and falling prices. During the next two decades, the Euro-American presence was limited primarily to U.S.-Government-sponsored exploratory expeditions.

The situation changed in 1859 with the discovery of gold on Cherry Creek near present-day Denver. The resulting influx of Euro-Americans into Ute territory led to conflict. In response, the treaty of 1868 established much of western Colorado as a reservation for the Utes, but subsequent discoveries of ore bodies in the San Juan mountains led to further conflict, and the Utes relinquished the San Juans in the Brunot Treaty of 1873, whereby the Moache, Capote, and Weeminuche Ute bands were restricted to the Southern Ute Reservation along the New Mexico border. Hostilities increased, which led to the Meeker Incident in 1879 and the removal of the White River and Uncompahgre Utes to reservations in northeastern Utah and southern Colorado (Reed 2006).

With the removal of the Utes, a limited amount of Euro-American farming and ranching increased along the canyon bottoms of the area, but it was the discovery of a parrot-yellow mineralization in a sandstone bed at the confluence of the Dolores River and Roc Creek about 1880 that led to the world's first discoveries of radioactive metals, in the form of carnotite ore, and to the development of the Uravan Mineral Belt. Historically, the prosperity of the towns of Bedrock, Nucla, and Naturita can be attributed to the construction of uranium- and vanadium-ore processing plants. As is a common occurrence with mining and mineral extraction, the Uravan Mineral Belt experienced a repeated boom-and-bust cycle tied to the supply of and demand for radioactive metals and vanadium. Six periods of historical significance have been identified for the Uravan Belt (Twitty 2008). The remains of the prospects, mines, roads, mining camps, drill pads, and other modifications of the landscape remain in the Uravan Mineral Belt. Those that retain their integrity and association with significant periods may be eligible for listing on the NRHP.

In the late nineteenth century, about the time that the Curies working in France were identifying radioactivity, it was discovered that carnotite ore, unique to the Uravan Mineral Belt, contained the radioactive metals of radium and uranium. The period from 1898 through 1905 was a time of interest in radium in Europe. A growing demand for radium, first in the scientific community and then in the medical industry, stimulated a minor wave of prospecting along the San Miguel and Dolores Rivers. Ore bodies were identified, and the first successful uranium extraction mills were built. However, the remoteness of the belt from Europe led Europeans to rely on pitchblende ores from eastern Germany as a more economical source of uranium and radium (Twitty 2008). Production in Montrose and San Miguel Counties collapsed in 1905.

In the following year, 1906, the construction of the first successful vanadium concentration mill at Newmire (later Vanadium) sparked a revival of mining. Vanadium was in demand as a hardening alloy used in steel production and was especially important for weapons production in Europe during World War I. San Miguel County proved to have rich deposits of roscoelite ore from which vanadium could be extracted. Radium was also in demand, especially after German sources were no longer available in the West. There was a mining boom and associated population growth. However, demand for both radium and vanadium collapsed in the early 1920s when sources were discovered in the Belgian Congo.

Mining in the Uravan Mineral Belt was much reduced until the middle of the Great Depression, when industry had revived enough to create a demand for vanadium. Development of vanadium milling continued, and large-scale companies came to dominate the industry, although smaller operations cumulatively provided a significant amount of ore. The process of vanadium revival accelerated between 1941 and 1945. During World War II, vanadium was in demand. The Government aggressively pursued vanadium production as a key component of weaponry and armor. In addition, under the guise of vanadium production, the Government sought uranium for use in the development of atomic weapons. The area contributed 15% of the uranium used in the Manhattan Project, mostly obtained by processing vanadium mill tailings.

By 1944, however, the U.S. Government's uranium production goals had been met, and in 1945, the bottom fell out of the uranium market. Some of the slack was taken up by the revival of industrial demand for vanadium. In 1947, the Federal Government formulated a strategy to stimulate the discovery, production, and milling of uranium from domestic sources. This became increasingly important during the Cold War. The industry was completely dependent on the Government, which strictly regulated uranium production. In the early 1960s, the U.S. Department of Defense's needs were almost fulfilled, and the AEC began to reduce its financial support of the uranium mining industry. The industry declined but then experienced a brief revival in the mid- to late 1970s, when vanadium was once more in demand for industry and uranium was needed for nuclear power production. Uranium prices collapsed once again in 1980, most of the mines closed, and the region lost much of its economic foundation (Twitty 2008).

3.11.2 Cultural Resource Inventories

The cultural resource site information discussed in this section was obtained from the Office of Archaeology and Historic Preservation in the state of Colorado in December 2011, from the State Historic Preservation Office of the Utah State Historical Society in March 2012, and from survey reports.

Cultural resource inventories can include both field surveys and documentary research studying the results of past field work in the area of interest. Archaeological surveys in the area were initiated by George and Edna Woodbury in 1931, but, by far, the majority of cultural resource surveys have been conducted in response to the requirements of Section 106 of the NHPA. Over time, the rigor and scope of these surveys have increased, so that, in general, Federal land-managing agencies (such as the BLM, which manages the surface resources of the lease tracts) regard the surveys conducted after about 1985 as adequate. Section 106 surveys provide the data that Federal agencies use, in consultation with the SHPO and affected tribes, to evaluate whether the identified sites meet the eligibility criteria for listing on the NRHP.

A cultural resource survey based on documentary evidence in past surveys and investigations is termed a Class I inventory by the BLM. In 2006, Alan Reed conducted a Class I cultural resource inventory of the lease tracts for DOE. He identified 126 mostly small-scale surveys conducted on the lease tracts. Since 2006, 13 additional surveys have been conducted. Table 3.11-1 shows the acreage of land that had been surveyed as of 2011. It shows that 2,800 acres (1,100 ha), or about 11%, of the 26,000 acres (10,500 ha) that lie within the lease tracts have been subjected to cultural resource surveys. This is a somewhat lower percentage than the survey coverage of lands in the surrounding 15 mi (24 km). Approximately 314,000 acres (127,000 ha), or about 18%, of the surrounding 1,700,000 acres (680,000 ha) have been surveyed according to geographical information system (GIS) layers provided by the Colorado and Utah SHPOs (Sullivan 2011; Miller 2012).

Archaeological site data on surveyed lands within 15 mi (24 km) surrounding the lease tracts are also available from the SHPOs. The tracts cluster into four groups, as described in Section 3.12. These four clusters vary somewhat from the named groups used in Section 3.3. Since setting and viewshed are important components of the integrity of historic properties, this section uses the groupings used in Section 3.12, Visual Resources; see Table 3.11-2.

The extent of archaeological survey coverage and the numbers of sites contained in the 15-mi (24-km) zones circumscribed around these four groups are listed in Table 3.11-3. Calculated site densities are also listed. Site density ranges from 24 to 35 sites per square mile, with density increasing from north to south. This increase may reflect a generally greater accumulation of prehistoric sites (especially those dating to the latter parts of prehistory) along a transect from higher to lower elevation and south toward the Ancestral Puebloan cultural heartland. These site data from the 15-mi (24-km) radius hinterlands also provide a basis for comparison with data from within the lease tracts proper, as summarized in Table 3.11-4.

Individual inventories in the northern cluster of lease tracts near Gateway reported site densities ranging between 13 and 69 sites per square mile (Reed 2006). This range brackets the average frequency of 24 sites per square mile derived from the surrounding 15-mi (24-km) zone. It also brackets the average of 43 sites per square mile determined from Colorado SHPO data for all the northern lease tracts (Sullivan 2011). The anomalously high site frequency figure of 69 sites per square mile is probably a result of sampling error.

One cultural resource inventory in the North Central tracts around Uravan reported a density of 11 sites per square mile (Reed 2006). This figure is less than half the density number derived from the survey in the surrounding 15-mi (24-km) zone. It is also much lower than the average site density within the tracts of 52 sites per square mile derived from SHPO data. The anomalously low number may be attributed to sampling error; however, only 12% of the North Central tracts have been surveyed (Sullivan 2011). Averages based on such small sample sizes may be misleading, especially where large numbers of mining-related sites may be clustered in relatively small areas.

TABLE 3.11-1 Cultural Resource Survey Coverage of the Lease Tracts

Lease Tract	Total Acreage of Lease Tract	No. of Acres Surveyed	Percentage of Total Surveyed
5	151	4	2.6
5A	25	–[a]	0.0
6	530	20	3.8
7	493	259	52.5
8	955	34	3.6
8A	79	3	3.3
9	1,037	12	1.2
10	638	56	8.8
11	1,503	103	6.8
11A	1,293	51	3.9
12	641	513	80.0
13	1,077	128	11.9
13A	517	111	21.4
14	972	7	0.7
15	350	11	3.3
15A	173	8	4.6
16	2,039	8	0.4
16A	811	9	1.1
17	475	5	1.1
18	1,181	313	26.5
19	664	2	0.2
19A	1,205	213	17.7
20	629	–	0.0
21	651	48	7.3
22	224	66	29.3
22A	408	35	8.7
23	596	40	6.8
24	201	1	0.4
25	639	32	5.0
26	3,991	523	13.1
27	1,763	151	8.6
Total	25,911	2,766	10.6

[a] A dash indicates not surveyed.

TABLE 3.11-2 Correlation of Lease Tract Cluster Designations

Geographic Clusters	Named Grouping
North Cluster	Gateway
North Central Cluster	Uravan + Lease Tracts 21-23
South Central Cluster	Paradox south of Paradox Valley
South Cluster	Slick Rock

TABLE 3.11-3 Cultural Resource Survey Coverage, Site Tallies, and Site Density within 15 mi (24 km) of Lease Tract Clusters

Lease Tract Cluster	Surveyed Acreage within a 15-mi Zone	Site Tally	No. of Sites per Acre	No. of Sites per Square Mile
North	40,830	1,498	0.0367	23.5
North Central	99,950	4,223	0.0423	27.0
South Central	96,451	5,029	0.0521	33.4
South	77,065	4,167	0.0541	34.6
Total	314,296	14,917	0.0475	30.4

TABLE 3.11-4 Cultural Resource Survey Coverage, Site Tallies, and Site Density within Each Lease Tract Cluster

Lease Tract Cluster	Surveyed Acreage within Cluster	Site Tally	No. of Sites per Acre	No. of Sites per Square Mile
North	662	43	0.0650	41.6
North Central	694	56	0.0807	51.6
South Central	326	19	0.0584	37.3
South	978	103	0.1053	67.4
Total	2,659	221	0.0831	53.2

South of Paradox Valley, in the South Central lease tracts, individual surveys reported site densities ranging from 21 to 54 sites per square mile (Reed 2006). This range evenly brackets the average of 33 sites per square mile determined for the surrounding 15-mi (24-km) zone. It also brackets the average site density of 37 sites per square mile derived from all previous surveys in the south central lease tracts. Even though only 11% of the South Central lease tracts have received archaeological survey coverage, site density figures generated for this area seem reliable.

In the South tracts near Slick Rock, individual surveys determined site density figures ranging from 14 to 31 sites per square mile (Reed 2006). Data from the surrounding 15-mi (24-km) zone produced an average of 35 sites per square mile. Colorado SHPO data indicated that surveyed land within the South Cluster lease tracts contained an average of 67 sites per square mile (Sullivan 2011). There are clear discrepancies among these results. It seems likely that the discrepancies are the result of incomplete survey coverage in the South Cluster lease tracts, where only 10% of the area has been surveyed.

All the lease tracts are near or overlap areas of known prehistoric occupation as well as areas of early Euro-American settlement, mining, and ranching (Reed 2006). Many of the lease tracts contain structures and artifacts associated with the early uranium mining boom in the United States; some of these features are considered historic and eligible for inclusion in the NRHP. The extent that each lease tract has been inventoried ranges from 0% to 80%. Forty-two individual cultural sites on the lease tracts were eligible for, or potentially eligible for, inclusion in the NRHP. These include sites that have been officially determined to be NRHP-eligible by Federal or state agencies, sites that have been recommended as eligible by site recorders but not formally evaluated by the agencies, and sites that are classified by either the agencies or the recorders as "needs data." These last sites require additional investigation to determine whether they are eligible for listing on the NRHP. They must be managed as if they were eligible until it is formerly determined otherwise.

Table 3.11-5 lists the number of eligible historic and prehistoric sites known from each tract. Of the 42 cultural sites identified within the tracts, 24 are prehistoric, 14 are historic, and 4 have both historic and prehistoric components. Most of the prehistoric sites are classified as either lithic scatters or as camp sites. In addition, one site is a rock art panel, and two are classified as rock shelters. Historic sites are predominantly mines but also include a highway, a cabin, and a mining camp (Reed 2006; Sullivan 2011).

One site associated with carnotite mining, Calamity Camp, is now listed on the NRHP but has been excluded from Lease Tract 26. It includes approximately 23 stone and wood structures, many of them constructed prior to 1922. At first, from the early 1900s through the early 1920s, radium was the resource sought. Later, the ore was processed for vanadium and uranium. This camp and others on Outlaw and Calamity Mesas, notably Foster Camp, Climax Camp, and Arrowhead Camp, served as community centers for miners and their families during the vanadium and uranium booms in southwest Colorado. To protect the structures and features associated with this camp, BLM and DOE agreed to a "No Surface Occupancy" area that includes and surrounds the camp. No cleanup or remediation work has or will take place within

TABLE 3.11-5 Eligible and Potentially Eligible Sites in the Lease Tracts

Lease Tract No.	No. of Eligible Sites[a]	Prehistoric	Historic[a]	Multicomponent
5	1	0	1	0
5A	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	2	1	0	1
8A	0	0	0	0
9	2	2	0	0
10	1	1	0	0
11	1	0	0	1
11A	1	1	0	0
12	2	2	0	0
13	4	1	2	1
13A	3	3	0	0
14	1	1	0	0
15	2	1	1	0
15A	0	0	0	0
16	0	0	0	0
16A	1	0	1	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
19A	6	6	0	0
20	0	0	0	0
21	3	1	2	0
22	2	0	2	0
22A	3	1	2	0
23	2	0	1	1
24	0	0	0	0
25	0	0	0	0
26	4	2	2	0
27	2	1	1	0

[a] One site, 5SM3670, straddles the boundary between two sites and appears twice in this table.

Source: Information obtained from the Office of Archaeology and Historic Preservation in the state of Colorado in December 2011.

this area, and no remediation or disturbance is allowed within a 98-ft (30-m) buffer zone surrounding the camp boundary.

Cultural site densities within DOE's lease tracts vary greatly. Cultural resource inventories on some of the South Cluster or Slick Rock lease tracts have indicated densities of 14, 31, 22, and 24 sites per square mile (Lease Tracts 10, 11, 13A, and 15, respectively) (Reed 2006). A total of 17 sites in the South Cluster lease tracts are eligible or potentially eligible for listing in the NRHP. An open lithic site in Lease Tract 10 is potentially eligible for inclusion in the NRHP. A prehistoric rock art site with a historic inscription is the only potentially eligible site in Lease Tract 11, and an Ancestral Puebloan site is the only potentially eligible site in Lease Tract 11A. An Archaic Period site with an Ancestral Puebloan component is an eligible site in Lease Tract 12, along with a potentially eligible Archaic site. Four sites in Lease Tract 13 are eligible or potentially eligible: (1) portions of a historic highway also known as CO 141; (2) an open lithic site; (3) a historic mining camp; and (4) a multicomponent site with a sheltered lithic component and historic trail. Three prehistoric sites in Lease Tract 13A are potentially eligible: (1) a possible Archaic open lithic site; (2) an open camp site with a historic prospect pit; and (3) an open camp site with a hearth feature and lithic remains. Lease Tract 14 has one potentially eligible site. It is an open lithic site of unknown cultural affiliation. Two sites in Lease Tract 15 are potentially eligible: (1) a possible Paleoindian open lithic site and (2) the Rimrock Cabins, a historic habitation site. Lease Tracts 16 and 16A are immediately adjacent to the aforementioned eligible historic highway (Sullivan 2011). A survey of historic mine features was conducted by Alpine Archaeological Consultants, Inc. (Moore-McMillian and Omvig 2009) in the South Cluster tracts; however, none of the mines documented were determined eligible for inclusion in the NRHP.

Cultural resource inventories on some of the lease tracts south of Paradox Valley reported densities of 54 and 53 sites per square mile (Lease Tracts 5 and 9, respectively) (Reed 2006). Two well-known cultural sites are located about 2 mi (3.2 km) southwest of Lease Tract 9: the Bull Canyon rock shelter, a prehistoric site; and Indian Henry's Cabin, a noneligible, late-nineteenth century site containing a well-preserved log cabin, corral, and grave site. A historic mine, the Joe Dandy #5 site, is the only eligible site located on Lease Tract 5. An open camp site with a historic rock ring is an eligible site on Lease Tract 8, where there is also a potentially eligible open lithic site. The two sites located on Lease Tract 9 are open camp sites that are potentially eligible for inclusion in the NRHP. The Radium Hill No. 10 Mine is an eligible historic site on Lease Tract 17 (Sullivan 2011).

North of Paradox Valley and near Uravan, inventories of 22, 32, and 21 sites per square mile were reported from Lease Tracts 21, 22, and 22A respectively (Reed 2006). Cultural resource inventories on Lease Tract 18 indicate a density of 11 sites per square mile (Sullivan 2011). Lease Tracts 19, 19A, 20, 24, and 25 are expected to have similar or higher site densities (Reed 2006). Six sites on Lease Tract 19A are eligible or potentially eligible for inclusion in the NRHP: four possible Archaic open camps; an open camp of unknown cultural affiliation; and a rock shelter with an isolated historic find.

Lease Tract 21 has two eligible historic mine sites and a prehistoric open camp (Sullivan 2011). One historic mine site is the Vanadium King No. 5 Mine; extant features of the mine consist of an inclined shaft, an explosives magazine, a hoist house, a track-and-rail system for ore car transportation, and an ore bin. The most intensive activity at the mine likely took place during the Atomic era (1946–1963), although the mine operated until 1992. The mine has retained enough integrity to illustrate uranium mining during the Atomic era and is therefore eligible for NRHP inclusion (Moore and Horn 2010). Long Park Nos. 1 and 16 Mines make up the other historic mine site. The principal remains of this site consist of a mine shaft, a waste-rock dump, head frame, hoist foundation, hoist house, ore bin, ore chute, blower foundation, storehouse ruin, and refuse dump. The No. 1 mine claim was initially located in 1912, and the No. 16 mine claim was located in 1939, and both claims were active until 1992 (Moore and Horn 2010). The site is considered eligible under Criterion A because of its association with the Cold War and under Criterion C because it is an outstanding example of a formally engineered, productive shaft mine (Twitty 2008).

Two sites in Lease Tract 22 are eligible for NRHP inclusion: the Cripple Creek/Donald C Mine, Shaft No. 1 and Shaft No. 2. The extant features of Shaft No. 1 consist of an inclined shaft, two waste-rock dumps, a hoist house foundation, a hoist house platform, a compressor house platform, two rail line remnants, a trestle remnant, a trestle, an ore bin, an ore loading area, a parking area, and a ventilation stack (Moore and Horn 2010). The remains of Shaft No. 2 consist of an inclined shaft, waste-rock dump, hoist foundation, rail line remnant, trestle ruin, parking area, trestle segment, and ventilation stack (Moore and Horn 2010). Both mines are eligible under Criterion A because of their association with the uranium boom in the 1950s as part of the Cold War and under Criterion C because they are excellent examples of inclined shaft mines for surface uranium drilling (Moore and Horn 2010).

Three sites in Lease Tract 22A are eligible or potentially eligible for the NRHP: Hidden Basin Mine; the Republican Camp historic mining site; and an open camp site. Hidden Basin Mine was initially located in 1944, and the extant remains at the site consist of an inclined shaft, waste-rock dump, hoist house remnant, incline frame, rail line remnant, trestle remnant, ore bin, loading area, utility pole, generator foundation, and low-grade ore piles (Moore and Horn 2010). One site, an open camp and historic sweat lodge on Lease Tract 23(3), is potentially eligible for the NRHP.

Cultural resource inventories of the Gateway or North Cluster lease tracts indicate a density of 24 sites per square mile (Sullivan 2011) (Table 3.11-3). Numerous sites associated with historical uranium mining are present. Lease Tract 26 contains four sites that are listed, eligible, or potentially eligible for NRHP inclusion. A late Archaic open camp site has been declared eligible for NRHP inclusion, as has another open camp site. An historic site has been declared eligible for the NRHP; it is known as the New Verde Mine and dates to the 1940s. The Radium No. 5 Mine is the fourth eligible site located on Lease Tract 26. The mine was first located in 1939 and is eligible under Criterion C because of the presence and integrity of the windlass artifact at the mine site (Horn and Moore-McMillian 2009). A historic mining complex is an eligible site located on Lease Tract 27, and a possibly Archaic open camp is potentially eligible on this lease tract.

Taken as a whole, the site distribution pattern found in the lease tracts suggests that prehistoric sites are most likely to be found (1) on level to gently sloping land forms, often on ridge crests or along mesa rims, within the juniper-piñon woodlands, and (2) along benches overlooking rivers and streams. Ranching sites are most likely located along river bottom lands. The distribution of mining sites is dictated by the presence of ore bodies. During the late nineteenth and early-twentieth centuries, these ore bodies were primarily located visually and tested by prospects, often along rims. Mining camps were located near the mines. Later, with the advent of coring, deeply buried ore bodies were discovered well away from the rims, and improvements in the road system allowed miners and their families to reside in the valley towns. In an area where water is scarce, there is little doubt that the development of the mineral belt resulted in historic mines, and settlements have already destroyed much of the prehistoric record in the area. Networks of roads connecting mines, prospects, and drill pads, along with the leveling done for mine facilities, waste rock disposal, and ore storage, are likely to have taken their toll on prehistoric remains as well.

3.11.3 Traditional Cultural Properties

Traditional cultural properties are properties that are associated with the cultural practices or beliefs of a community and are significant to the community's history or may be important in maintaining the community's cultural identity. They can include archaeological sites; burial sites; rock art; culturally important resources such as plants important for medicine or in rituals; natural features such as mountain peaks, springs, caves, and distinctive rock formations; and sacred landscapes. In many cases, they cannot be identified without input from the community that considers them sacred or otherwise culturally important.

Traditional properties may not be readily identifiable during a Class I inventory or a Class III field inventory (required prior to any new surface disturbing activity) alone. A Class III field inventory is an intensive survey of an entire target area, aimed at locating and recording all cultural resources (archaeological sites, historic structures, historic and cultural landscapes, and traditional cultural properties) that have surface indications, and it is performed by walking close-interval, parallel transects until the area has been thoroughly examined. The NHPA requires that these properties or places be considered by Federal agencies in the same manner as are other eligible cultural resources through the Section 106 consultation process.

In order to help identify traditional cultural properties in the study area that could be affected by the proposed alternatives, DOE contracted with a cultural anthropologist in 2006 (Fritz 2006). He identified three Native American tribes with potential historical and cultural ties to the lease tract, the Navajo, the Hopi, and the Utes. These tribes retain cultural ties to their traditional homelands that can lie well beyond the boundaries of their current reservations. They include sacred landscapes, often the settings for traditions regarding tribal emergence. They may believe they have a divinely mandated stewardship over these sacred lands. The tribes and their interests are described briefly here.

- *Navajo.* The Navajo take the view that they have always lived "among the four sacred mountains," having emerged from the four underworlds into this world at Mount Blanca (Two Bears 2012). However, according to linguistic and archeological evidence, today's Navajo, along with the Apache, coalesced out of Athabaskan-speaking groups that probably entered the Southwest from the north only relatively recently. One possible migration route is an intermountain one through western Colorado and eastern Utah that would include the lease tracts. Although evidence is scarce, it is likely that at least some Athabaskan groups entered the study area prior to the fifteenth century. It is possible that early Navajo sites may be found in the area. By the sixteenth and seventeenth centuries, traditional Navajo lands included the canyon tributaries of the San Juan River, Los Pinos River, and Animas River. Some Navajo people were in alliance with the Ute and Paiute peoples in Moab and the Lisbon Valley area close to the lease tract by the mid-nineteenth century (Fritz 2006). In the twentieth century, some Navajos became skilled miners and worked underground in the Uravan Mineral Belt mines. Traditional Navajo hogans and sweat lodges have been documented in the area (Twitty 2008).

- *Hopi.* The Hopi are a Puebloan people whose traditional villages currently lie on three mesas in northern Arizona. However, their current reservation encompasses only a fraction of their traditional sacred and ancestral homeland, or *Tutsqua*. Hopi clans have traditional migration narratives that link them to places north and east of their current home. They are linked to an extensive network of ancestral sites, often marked by clan rock art, that include burial sites, shrines, medicinal gathering places, ancient farming lands, and the habitat for the animals after which the clans are named. They see themselves as descending from the Ancestral Puebloan cultures of the Southwest, including those known to archaeologists as the Fremont and Ancestral Puebloan cultures. The Hopi feel bound to *Tutsqua* by a long history and a powerful spiritual covenant that includes a divine mandate to act as stewards of the land. The lease tracts fall within the northern extent of *Tutsqua* (Fritz 2006).

- *Ute.* As already discussed, the Ute Indians are the Native Americans who most recently dominated western Colorado. The lease tracts lie within the heart of the Ute homeland. Traditionally, Ute populations have been identified living along the Dolores River, along the San Miguel River, in Paradox Valley, and on the Uncompahgre Plateau. Traditional Ute creation and migration narratives and ceremonies, such as the Bear Dance, derive from the natural world. Traditionally, the Utes see the landscape as infused with sacredness and as a source of spiritual power. Utes were traditionally hunters and gatherers following a seasonal round. Ute ceremonial and subsistence patterns incorporate an extensive array of plants, and more than 100 species have been recorded. These indications suggest a high potential for traditional gathering areas within the lease tracts. In spite of their forced removal from their traditional homeland, the Utes have retained a strong bond to these locations (Fritz 2006).

> A recent BLM project brought Utes from Utah and Colorado to areas that included the northern half of the lease tracts to explore their ties to their traditional homeland. They expressed deeply held values on living landscapes and landforms that once were home to their ancestors or figured in their cultural traditions. They were interested in the preservation of Ute trails and wickiup sites. They expressed the importance of preserving access to locations of traditional importance as well as to traditional plant resources. Ute archaeological sites often include wooden surface features, such as wickiups, tree platforms, ramadas, hunting blinds, brush fences, and corrals that, in the past, have not always been recognized as having Ute affiliation (Ott et al. 2010).

In 2006, communication was attempted with Native American tribal members who might have knowledge of such traditional cultural properties being important to the tribes in the lease tracts. During the preparation of the earlier environmental assessment, DOE formally initiated the NHPA consultation process by notifying potentially interested Native American tribes that resided in or had cultural ties to the project area to inform them of DOE’s proposed alternatives and to solicit their concerns or comments. A total of 11 representatives from five Native American tribes—the Ute Mountain Ute Tribe (including the White Mesa Ute Tribe), Southern Ute Tribe, Uintah-Ouray Ute Tribe, Navajo Nation, and Hopi Tribe—were contacted by mail, telephone, and e-mail. All representatives were contacted again in July 2006 and given a copy of the Class I inventory. Follow-up phone calls and e-mails continued through November 2006. Responses were received from four tribes: the Ute Indian tribe of the Uintah and Ouray Reservation; the Ute Mountain Utes; the Hopi; and the Navajo Nation. Both the Utes and the Navajo both requested additional information. The Hopi responded that the area was not a high priority, while the Ute Mountain Utes indicated that the area involved was too small (Fritz 2006). To date, no tribe has made a determination regarding traditional cultural properties on the lease tracts, primarily because future, site-specific development activities and the cultural sites they might affect have not yet been determined. Section 6.1 presents a discussion of government-to-government consultations being conducted for the ULP PEIS.

3.12 VISUAL RESOURCES

For this discussion, the lease tracts were divided into four groups:

1. North Group: Lease Tracts 27 and 26;

2. North Central Group: Lease Tracts 25, 24, 23T-3, 23T-2, 23T-1, 22, 22A, 21, 20, 19, 19A, and 18;

3. South Central Group: Lease Tracts 17T-2, 17T-1, 9, 8, 8A, 7, 6, 5, 5AT-3, and 5AT-2; and

4. South Group: Lease Tracts 16, 16A, 15, 15A, 14T-3, 14T-2, 14T-1, 13, 13A, 12, 11, 11A, and 10.

The North Group is located within Mesa County, east of the Dolores River. The North Central Group and South Central Group are located within Montrose County; however, portions of Lease Tract 17 straddle the borders of Montrose and San Miguel Counties. The South Group is located entirely within San Miguel County adjacent to the Utah–Colorado border (Figure 3.12-1). These groups, as well as portions of these groups, are analyzed for impacts resulting from activities associated with Alternatives 1 through 5.

The grouping of lease tracts for the visual impact analysis differs from the named groupings used in other portions of the ULP PEIS; the requirements of the visual impact analysis dictate that lease tracts in close physical proximity be analyzed as a group, because they will have views of approximately the same landscape. Lease tracts 21–23 north of Paradox Valley have viewsheds (i.e., visible areas of the surrounding landscape) that are similar to those in the Uravan Lease Tracts, but have very limited visibility of lands within Paradox Valley and south of the valley. Lease tracts 6–9 of the Paradox Valley lease group have extensive views of Paradox Valley and lands south of Paradox Valley. Combining the viewsheds of the lease tracts south of Paradox Valley with those north of Paradox Valley would have generated misleading results that would have implied that the more northern lease tracts would have views of activities south of Paradox Valley. This problem was avoided by grouping the lease tracts of the Paradox Valley lease group north of Paradox Valley with the Uravan lease tracts.

3.12.1 Regional Setting

This region within Colorado historically has been utilized for mining activities, including the exploration and development of coal, oil, and gas; sand and gravel; and radium, uranium, and vanadium.

Natural vegetation on and near the lease tracts varies from grasses and shrubs to woodlands of piñon-juniper and Gambel oak. The land forms are characterized by a range of features, including high mountain peaks, rolling plains, basins, valleys, and rock outcrops (Chapman et al. 2006), creating a highly variable landscape with numerous colors, textures, forms, and lines. The three counties are characterized by diverse landscapes consisting of valleys, mesas, and plateaus. Within Mesa County, approximately 76% of the land is publicly owned and controlled.

Montrose County is bisected by the Uncompahgre Plateau. In this county, the area west of the plateau is known traditionally as the West End Planning Area; it contains the towns of Nucla and Naturita, as well as several unincorporated communities. In this area, mining has been a longstanding industry, and similar to land in Mesa County, much of the land in this area is publicly administered. The West End has numerous natural resources, including the Dolores River, which cuts across Paradox Valley (Montrose County 2010a), and the San Miguel River. Portions of this county are also designated for their unique and/or specific environmental, historic, and recreational qualities (e.g., Tabeguache Wilderness, the Unaweep Tabeguache Byway, the Dolores River Canyon SRMA, the Dolores River Canyon Wilderness Study Area, and the Hanging Flume).

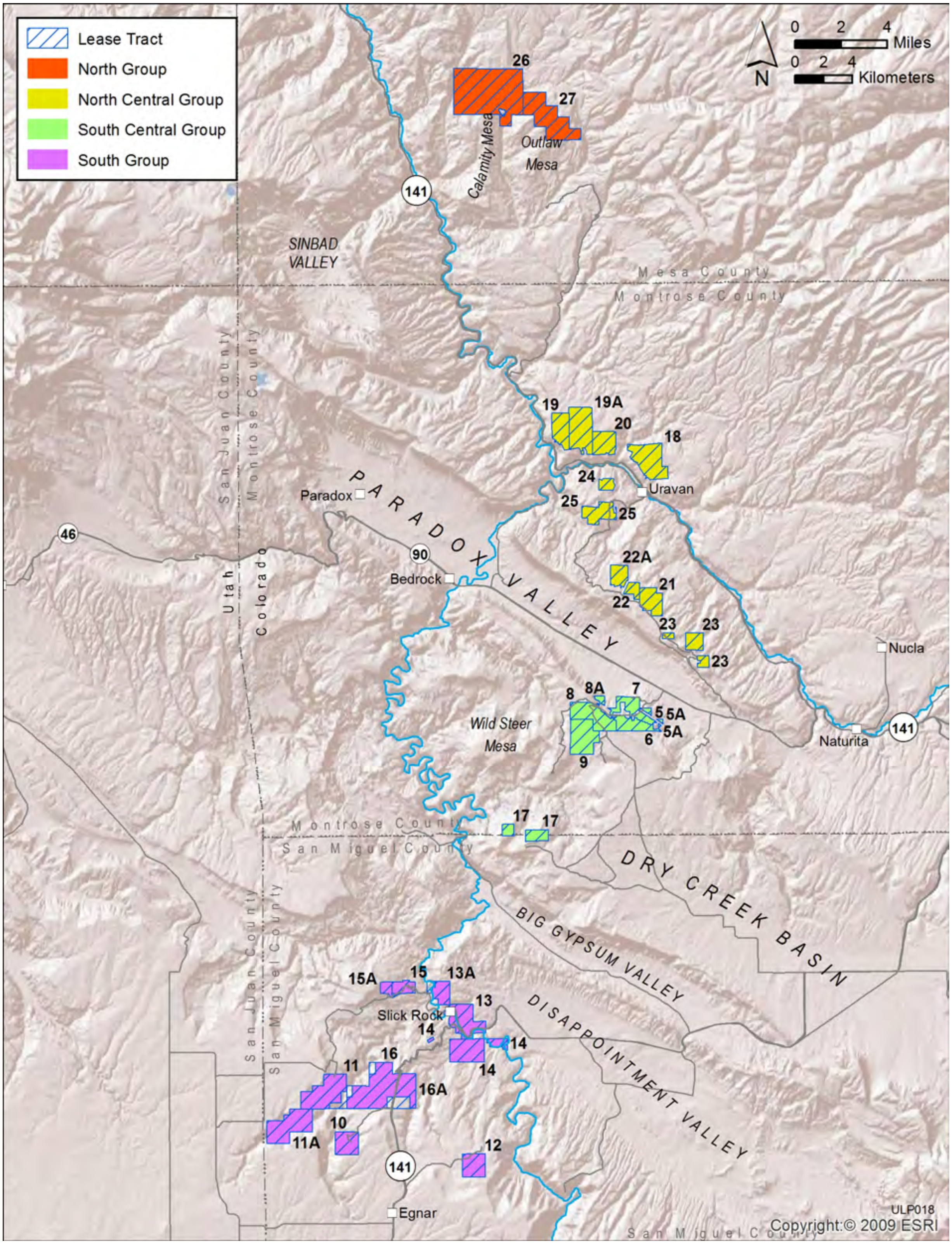


FIGURE 3.12-1 Locations of the Four Lease Tract Groups: North; North Central; South Central; and South

Portions of the lease tracts within San Miguel County are located in the county's West End, as it also is known locally. In San Miguel County, this area includes locations within the Dry Creek Basin, Disappointment Valley, Slick Rock, and Egnar. This area is noted for its wildlife, historical and archaeological sites, natural resources, and landmarks. One of the main goals of the county comprehensive land management plan is to develop the county's natural resources in a way that would maintain the high overall quality of life enjoyed by its citizens. As part of this goal, the county intends to preserve the natural beauty of the San Miguel West End (San Miguel County 2008). Similar to both areas in Mesa and Montrose Counties, areas designated for their unique and/or environmental/recreational qualities also are located within the western portion of the county.

3.12.2 Lease Tracts

Many of the lease tracts are located along the tops and side slopes of broad mesa tops and benches, as well as within Dolores Canyon and Paradox Valley. During the October 2011 site visit, ephemeral streams also were noted, including some located within Paradox Valley. In some locations, such water sources have created deep incisions into the valley floors. The Dolores and San Miguel Rivers are major features in this area as well and are visible from elevated locations and within the canyons themselves.

Numerous unpaved, dirt and gravel roads cross the areas containing the lease tracts. Many of these roads lead to the individual tracts, providing an interconnected system of state and local roadways. In addition to the roads, other evidence of past mining activities in the region is present, including structures such as ore bins, head frames, gates, and water tanks. Similar types of structures likely would be utilized if mining activities were to continue. Views of the lease tracts and surrounding areas, including existing cultural modifications, are shown in Figures 3.12-2 through 3.12-8.

As observed during an October 2011 site visit, vegetation colors included yellows, greens, and browns, with variable textures and heights sufficient to add some visual interest. Varying levels of intermediate and full growth were indicated within the lease tracts as well. Depending on the season, some or all of the vegetation may be snow-covered or subject to color changes, which could affect the visual qualities of the area. In addition, ongoing reclamation efforts also could alter the existing vegetation.

A GIS viewshed analysis was conducted for each of the four groups of lease tracts. Viewshed calculations were performed by using National Elevation Data (NED) 10-meter Digital Elevation Model (DEM). The analyses included lands within 25 mi (40 km) of the lease tract borders. The ROI for visual resource analysis was set at 25 mi (40 km) because it is the approximate limit at which non-negligible visual contrasts from the structures and landforming activities in the proposed action could reasonably be expected to be visible in this region, assuming favorable viewing conditions and strong contrast between an object and its background. The analyses were conducted by assuming a target height of 30 ft (9 m) and a viewer height of 5 ft (1.5 m) (see Figure 3.12-9). The target height is the approximate maximum

FIGURE 3.12-2 View from the Western Edge of Lease Tract 26 Facing Southwest (The La Sal Mountains are in the background.)

FIGURE 3.12-3 View from Mesa Top near Lease Tract 19 Facing West (showing the Dolores River in the middle ground area)

FIGURE 3.12-4 View of Lease Tract 16A (showing the rubble pile from the previous open-pit mining activities)

FIGURE 3.12-5 View of the Cotter Mine on Lease Tract 11 (Remnants of previous activities are indicated by the presence of the water tank.)

FIGURE 3.12-6 View of the New Verde Mine Reclamation Site on Lease Tract 26 (Remnants of mining structures and an ore bin are present.)

FIGURE 3.12-7 View of Lease Tract 19 Facing West (A headframe structure is located above the closed shaft of the Golden Cycle underground mine.)

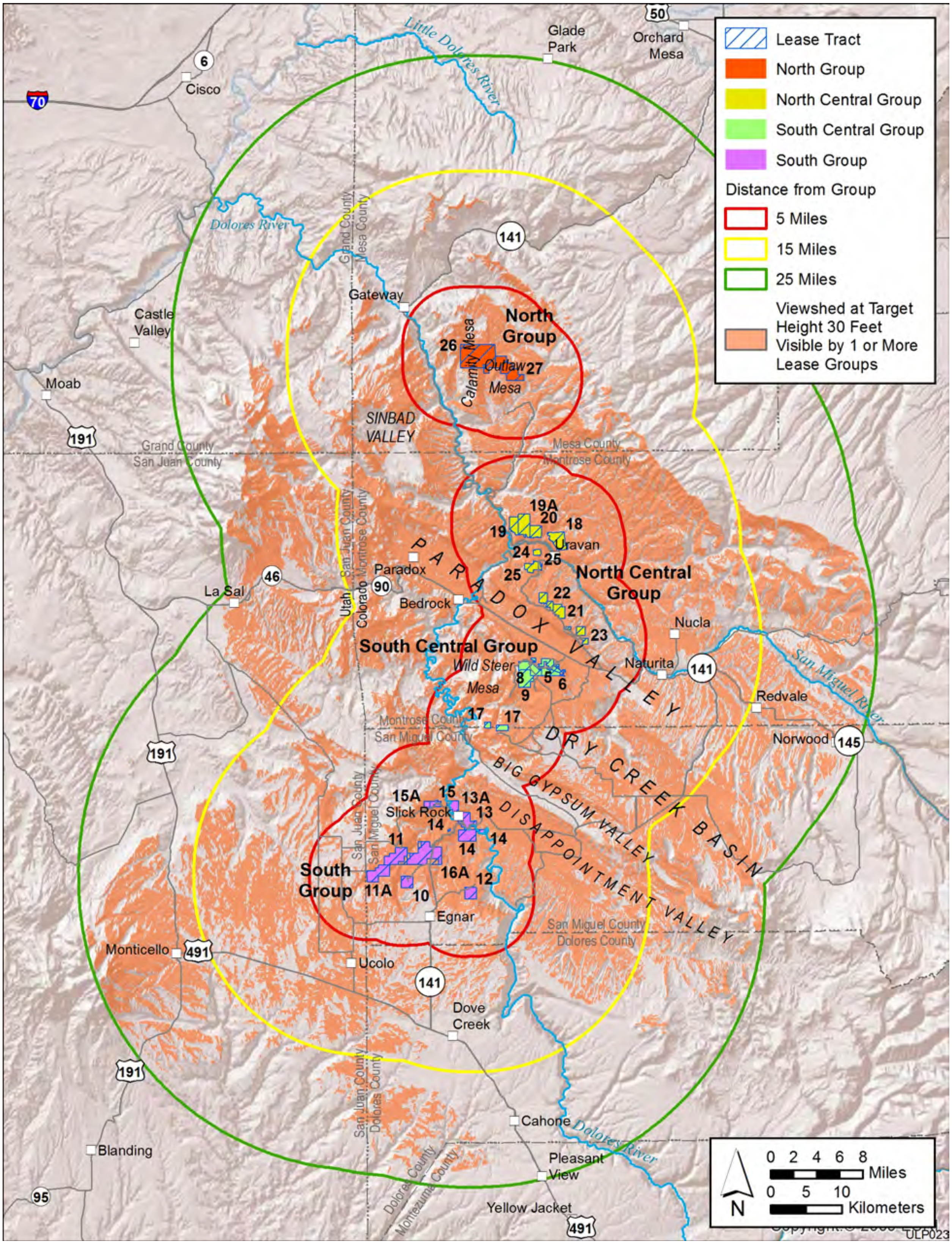
FIGURE 3.12-8 View of Entrance to Underground Mine at Lease Tract 18 (The Cotter Mine entrance has a locked gate to prevent unauthorized entrance and is covered with fabric to control ventilation.)

height of structures or other modifications to the landscape anticipated to cause visual contrasts associated with the proposed action or alternatives. The viewshed analyses did not take into account the height or screening potential of surrounding foliage or trees. The viewshed analysis did account for earth curvature and atmospheric refraction.

In addition to the overall viewshed, SVRAs were considered in each of these analyses. These areas included the following:

- National Parks, National Monuments, National Recreation Areas, National Preserves, National Wildlife Refuges, National Reserves, National Conservation Areas, and National Historic Sites;
- Congressionally authorized Wilderness Areas;
- Wilderness Study Areas;

1



2 **FIGURE 3.12-9 Composite Viewshed of Four Lease Tract Groups**

- National Wild and Scenic Rivers and Congressionally authorized Wild and Scenic Study Rivers;

- National Scenic Trails and National Historic Trails;

- National Historic Landmarks and National Natural Landmarks;

- All-American Roads, National Scenic Byways, State Scenic Highways, and BLM- and USFS-designated Scenic Highways and Byways;

- BLM-designated Special Recreation Management Areas; and

- Areas of Critical Environmental Concern.

Figure 3.12-10 shows the composite viewshed with SVRAs overlaid. No Nationally Wild and Scenic Rivers or Congressionally authorized Wild and Scenic Study Rivers were found to occur in the study area.

3.12.2.1 North Group

The north group of lease tracts is located within the Uncompahgre Plateau, east of Maverick Canyon, on the Calamity and Outlaw Mesas. Elevation within this grouping varies between 5,700 and 7,000 ft (1,700 and 2,100 m). Calamity Creek, Indian Creek, and Cow Creek run through the lease tracts in this grouping. The town of Gateway is located approximately 5.5 mi (8.8 km) northwest of the lease tracts. Off-site views from the northern lease tracts include the Uncompahgre Plateau to the northeast–east, the Dolores River to the west, and the La Sal Mountains to the south–southwest (see Figure 3.12-9). Views to the south also include a mountainous area consisting of mesa tops and canyons cut by tributaries of the Dolores River.

A preliminary viewshed analysis was conducted to identify which lands surrounding the North Group would potentially have views of the activities and infrastructure within the lease tracts. The methodology for this reverse viewshed analysis is provided in Appendix D; this analysis considered Federal, state, and BLM-designated sensitive visual resources. Table 3.12-1 provides a list of SVRAs that would have potential views of the North Group. As shown, the lease tracts within the North Group would be visible from nearly 38% (7,500 acres [3,000 ha]) of the Sewemup WSA, while the North Group would be visible from less than 1% (2 acres [0.8 ha]) of the Tabeguache Wilderness. Figure 3.12-10 illustrates the location of these areas.

Calamity Mine, an NRHP site, is a 38-acre (15-ha) historical mining complex located on Lease Tract 26. A 98-ft (30-m) buffer has been instituted around the site; however, activities within portions of Lease Tract 26 would likely be visible from the camp within the BLM foreground distance of 0 to 3–5 mi (5–8 km), assuming that vegetation did not screen these areas from view of the camp. Distant views (13–25 mi [21–40 km]) of activities within some of the lease tracts in the North Central group would also be possible, assuming that vegetation did not screen these areas from view of the camp.

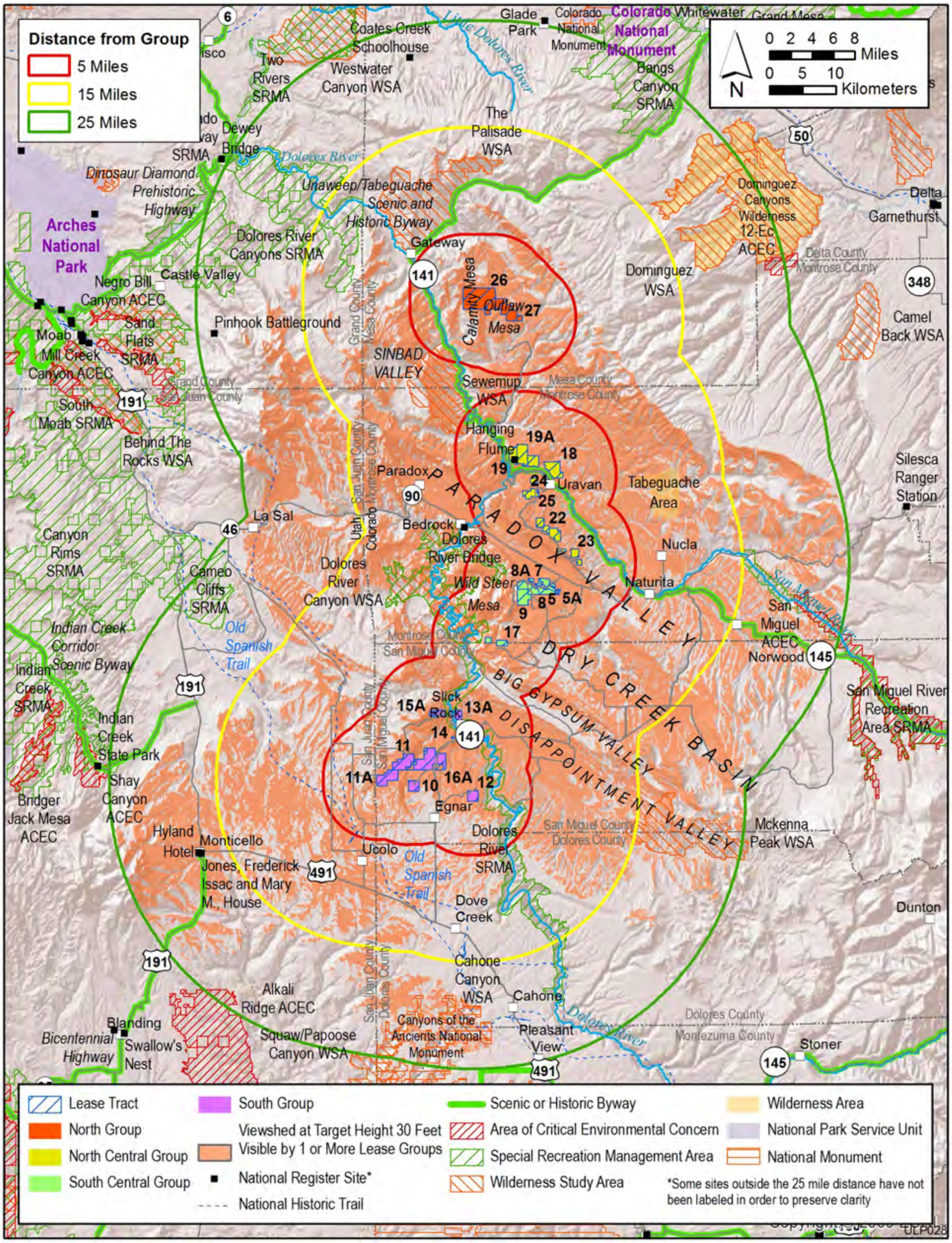


FIGURE 3.12-10 Composite Viewshed with Overlay of Sensitive Visual Resource Areas

TABLE 3.12-1 Sensitive Visual Resource Areas with Potential Views of the North Group

		Acreage Visible		
SVRA	Total Acreage	Within 5 mi	Within 15 mi	Within 25 mi
The Palisade ONA ACEC[a]	23,645	0	555	555
Unaweep/Tabeguache Scenic and Historic Byway	41,348	4	67	67
Dolores River SRMA	65,278	0	0	124
Dolores River Canyon WSA	29,169	0	0	122
Sewemup WSA	19,627	639	7,519	7,519
The Palisade WSA	26,654	0	387	387

[a] The Palisade (ONA) ACEC was designated in part for its high scenic values; therefore, it is being considered in this analysis.

3.12.2.2 North Central Group and South Central Group

The center two groupings of lease tracts are bisected by Paradox Valley. The elevation within these groups varies between 5,000 and 7,200 ft (1,500 and 2,200 m). Portions of these two groupings are located along the Atkinson Mesa, Club Mesa, and Monogram Mesa. Atkinson Creek, a tributary of the Dolores River, crosses through Lease Tract 18.

Highway 141 also runs within the grouping, passing between Lease Tracts 24 and 19, 19A, 20, and 18; this roadway follows the Dolores River and San Miguel River. Hanging Flume, a site on the NRHP, is located west of Lease Tract 19 along this highway. Highway 141 in this area is also known as the Unaweep/Tabeguache Scenic and Historic Byway.

Views from the North Central Group include mountainous areas consisting of mesa tops and canyons in all directions, as well as the Paradox Valley, which is located south of the lease tracts. The Manti La Sal National Forest is also visible from these lease tracts, especially those lease tracts located closest to the Colorado–Utah border. The historic town of Uravan, which is no longer populated, is located within the grouping, between Lease Tracts 18 and 25. The lease tracts likely would not be visible from the valley due to the surrounding topography.

A viewshed analysis was conducted to illustrate areas within the SVRAs that would have views of the lease tracts in the North Central Group. Table 3.12-2 provides a list of these locations. The North Central Group would be visible from 4,800 acres (1,900 ha), or 58.6%, of the Tabeguache Wilderness. In addition, four SVRAs would have views not only of the North

TABLE 3.12-2 Sensitive Visual Resource Areas with Potential Views of the North Central Group

SVRA	Total Acreage	Acreage Visible		
		Within 5 mi	Within 15 mi	Within 25 mi
San Miguel ACEC[a]	24,204	0	0	51
Unaweep/Tabeguache Scenic and Historic Byway	41,348	4,067	6,097	8,820
Dolores River SRMA	65,278	0	879	879
San Miguel River SRMA	39,373	0	0	285
Tabeguache Wilderness	8,187	0	4,802	4,802
Dolores River Canyon WSA	29,169	0	860	860
Sewemup WSA	19,627	309	6,947	6,947

[a] The San Miguel ACEC was designated in part for its high scenic values; therefore, it is being considered in this analysis.

Central Group but also of the lease tracts within the North Group; they are the Dolores River SRMA, the Tabeguache Area, the Dolores River Canyon WSA, and the Sewemup WSA.

Areas within the South Central Group have views down to the Paradox Valley, the Dolores River SRMA, and the Mt. Pearle Ecological Research Natural Area (ERNA). Portions of the North Central Group are also within view of elevated locations in the South Central Group, and there is intervisibility between the individual lease tracts within the South Central Group.

A preliminary viewshed analysis was conducted to identify which lands surrounding the South Central Group would have views of the lease tracts. Table 3.12-3 provides a list of SVRAs that have potential views of the lease tracts in the South Central Group. As shown, all the areas listed have views of both the South Central Group and the North Central Group. One additional area, the McKenna Peak WSA, has potential views of the South Central Group. The South Central Group is visible from approximately 720 acres (290 ha), or 3.5%, of this WSA.

The SVRAs within the 25-mi (40-km) viewshed of the North Central and South Central Groups are depicted in Figure 3.12-10.

TABLE 3.12-3 Sensitive Visual Resource Areas with Potential Visibility of the South Central Group

SRVA	Total Acreage	Acreage Visible		
		Within 5 mi	Within 15 mi	Within 25 mi
San Miguel ACEC[a]	24,204	0	0	21
Unaweep/Tabeguache Scenic and Historic Byway	41,348	0	1,053	3,789
Dolores River SRMA	65,278	3,239	8,394	8,937
San Miguel River SRMA	39,373	0	0	285
Tabeguache Wilderness	8,187	0	3,660	3,744
Dolores River Canyon WSA	29,169	3,196	6,485	6,485
McKenna Peak WSA	19,927	0	0	715
Sewemup WSA	19,627	0	0	1,580

[a] The San Miguel ACEC was designated in part for its high scenic values; therefore, it is being considered in this analysis.

3.12.2.3 South Group

The South Group of lease tracts lies to the west–southwest of Disappointment Valley, Big Gypsum Valley, and Dry Creek Basin near Slick Rock. Elevation within this part of the region varies between approximately 5,400 and 8,000 ft (1,650 and 2,400 m). The Dolores River crosses various lease tracts within this grouping. Portions of the Dolores River SRMA are within these lease tracts as well. Highway 141 also crosses through the South Group within Lease Tract 13 and along the borders of Lease Tracts 16 and 16A.

Off-site views from the southern lease tracts include the Dolores River and the Dolores River SRMA. Views to the north also include the South Central lease tracts; to the northwest, Mt. Peale ERNA is also visible from this group. Views to the east include the San Miguel ACEC, the San Miguel River SRMA, the Tabeguache Wilderness, and the Unaweep/Tabeguache Scenic and Historic Byway. In addition, views to the south include the Canyon of the Ancients National Monument; views to the southeast include McKenna Peak WSA and areas within the San Juan National Forest. There is intervisibility among the individual lease tracts within the group as well.

Similar to the analyses for other three groups, a preliminary viewshed analysis was conducted to determine which lands would have potential views of the lease tracts within the

South Group. Table 3.12-4 provides a list of these SVRAs. The South Group is visible from seven of the SVRAs. Of these seven SVRAs, three also have potential views of locations in another lease tract group—the Dolores River SRMA, the Dolores River Canyon WSA, and the McKenna Peak WSA. Figure 3.12-10 shows the location of these areas within the South Group lease tracts.

3.12.3 Visual Resource Management

The lease tracts are located within three BLM field offices: the Tres Rios; Grand Junction; and Uncompahgre Field Offices. In 2009, the Uncompahgre and Grand Junction Field Offices conducted visual resource inventories (VRIs). These inventories included an evaluation of lands contained within some of the lease tracts in the North, North Central, and South Central Groups (Otak, Inc. 2009).[24]

A BLM VRI evaluates BLM-administered lands in terms of their scenic quality, sensitivity level (in terms of public concern for preservation of scenic values in the evaluated lands), and distance from travel routes or key observation points (KOPs). On the basis of these three factors, BLM-administered lands are placed into one of four VRI classes, which represent the relative value of the visual resources. Class I and II are the most valued; Class III represents a moderate value; and Class IV represents the least value. Class I is reserved for specially designated areas, such as national wildernesses and other Congressionally and administratively designated areas for which decisions have been made to preserve a natural landscape. Class II is the highest rating for lands without special designation. More information about the VRI methodology is available in *Visual Resource Inventory, BLM Manual Handbook 8410-1* (BLM 1986a).

Within the Grand Junction Field Office, Lease Tracts 26 and 27 (i.e., the North Group) contain lands assigned a value of VRI Class IV (Scenic Quality Rating Unit 53 – Maverick Mesa), indicating low relative visual values.

Within the Uncompahgre Field Office, Lease Tracts 5, 5A, 6, 7,8, 9, 21, 22, 22A, 23, 24, and 25 (i.e., portions of the North Central and South Central Groups) contain lands assigned a value of VRI Class III, indicating moderate relative visual values. These lease tracts are located in areas defined by their exposed rock faces and mixtures of sage, piñon-juniper, and ponderosa vegetation, as well as by their steep elevation grade from the Paradox Valley and existing mining activities (Otak, Inc. 2009).

Lease Tract 7 (i.e., a lease tract within the South Central Group) primarily contains areas that are assigned to VRI Class III; however, a small portion in the northwest corner is located within an area assigned a value of VRI Class II. The areas contained by this lease tract are defined by an enclosed valley that is surrounded by prominent cliff faces, as well as the presence of the Dolores River and West Paradox Creek.

[24] Data were not available for the Tres Rios Field Office as of April 2012.

TABLE 3.12-4 Sensitive Visual Resource Areas with Potential Views of the South Group

SRVA	Total Acreage	Acreage Visible		
		Within 5 mi	Within 15 mi[a]	Within 25 mi[a]
Canyons of the Ancients National Monument	181,629	0	0	1,111
Dolores River SRMA	65,278	7,098	8,283	8,391
Cahone Canyon WSA	9,154	0	0	794
Dolores River Canyon WSA	29,169	0	1,100	1,205
McKenna Peak WSA	19,927	0	246	5,421
Squaw/Papoose Canyon WSA	5,017	0	0	46
Trail of the Ancients	46,181	0	0	1,748

Lease Tracts 18, 19, 19A, and 20 (i.e., portions of the North Central Group) primarily include lands that are assigned a value of VRI Class III, although portions of the lease tracts contain areas indicated as VRI Class II. These lease tracts include areas defined by open, rolling landscapes with low hills and gentle drainages, as well as lands characterized by dominant vegetation and a long canyon. The VRI for the areas contained by these lease tracts suggests that former uranium mines and milling are present where reclamation has “significantly reduced visual evidence of human impact” (Otak, Inc. 2009).

A viewshed analysis was conducted for each of the four groups of lease tracts. The viewshed analyses included lands within 25 mi (40 km) of the lease tract borders.

Once VRI classes are established, the information obtained can be used, along with considerations for other land uses, to determine the visual resource management (VRM) objectives for the field office. The VRM system provides guidance for future decisions that allow for protection of visual resources (BLM 2010b). The VRM classes are prescribed within the resource management plans (RMPs) for the individual field offices and district offices.

The Grand Junction RMP includes the North Group lease tracts. The Grand Junction RMP is currently being updated, and the new RMP is anticipated for the spring of 2014 (BLM 2011d).

A majority of the lease tracts within the North Central and South Central Groups are located within lands managed by the Uncompahgre Field Office, while portions of Lease Tracts 9 and 17 are within lands managed by the Tres Rios Field Office. The South Group lease tracts also are located on lands managed by the Tres Rios Field Office.

The Uncompahgre and Tres Rios Field Offices are participating in ongoing revisions of their 1988 and 1985 land use plans, respectively (BLM 1985, 1988).

For the Uncompahgre Field Office, the RMP update process began in the winter of 2009–2010. The final RMP is anticipated for completion in late summer of 2014 (BLM 2010a). According to the RMP Planning Fact Sheet on VRM for this field office, VRM classes that were prescribed in the 1985 and 1989 RMPs “are now insufficient to be used as a management tool because of data inconsistencies and the outdated nature of the class designations” (BLM 2010b). As part of the RMP revision process, all land within the planning area was reevaluated and assigned to a VRI class (BLM 2010b).

The Tres Rios Field Office is involved in the revision of its RMP as part of the San Juan Public Lands RMP revision; that RMP covers the field offices of Dolores (now Tres Rios), Columbine, and Pagosa (BLM 2007b). The Draft EIS for that RMP was prepared in 2007, with a supplement prepared in August 2011. The VRM classes have not yet been established; four alternatives for these classes are presented in the Draft EIS (BLM 2007a).

More information about the BLM VRM program is available in *Visual Resource Management*, *BLM Manual Handbook 8400* (BLM 1984).

3.13 WASTE MANAGEMENT

Waste rock is generated as the ore is segregated from the host and/or cover rock during underground or surface open-pit mining. Mines in the area where the DOE ULP lease tracts are located are expected to generate 2 to 3.5 tons of waste rock per ton of ore (Energy Fuels Resources Corp. and Greg Lewicki and Associates 2008). Once the waste rock has been generated, it can be placed or piled up in a designated area on the mine site that is commonly referred to as the waste-rock area. The optimal locations for waste-rock areas are outside drainages and flat areas where water runoff can be controlled. This approach also facilitates subsequent reclamation activities. Typically, some percentage of the waste rock generated can be placed back into mine openings during reclamation activities. However, a large percentage does remain on the surface, and it is eventually graded to slope that is consistent with the surrounding area, covered with surface soil materials and seeded.

In addition to the waste rock, other waste material is generated while mining activities are conducted; such wastes include the following:

1. Waste (primarily solids) from the treatment of water containing uranium and other metals in concentrations exceeding those specified in the surface water discharge standards. The treated water is then discharged in a manner consistent with discharge permits, and the solid residue is accumulated, dried out, and packaged for off-site disposal (e.g., to a mill or licensed low-level radioactive waste facility).

2. Used oil, antifreeze, and solvents from maintenance activities. These wastes are given secondary containment while they are stored on site in accordance with Federal and state regulations. Then they are transported to a permitted facility for recycling or for disposal.

3. Other solid waste materials generated (including concrete from ore pads and foundations, drill steel, mine timbers, and vent bags). Materials exceeding standards are either placed back into mine workings or taken to a mill for uranium recovery. Inert materials, such as the foundation and concrete, are broken up and buried on the site. These wastes can also be taken to a recycling or a permitted landfill (e.g., landfills located near Nucla or Naturita, Colorado). Soils containing contaminants inherent in the ore are managed as radioactive material. Pollutants, contaminants, wastes, or contaminated media that are not inherent to site geology are be removed from the site and managed as waste under state or Federal regulations.

With regard to sanitary waste, small mines are typically equipped with portable facilities, and these are removed from the site and disposed of. Leach fields with septic tanks are typically found in larger mine operations so that gray water or sanitary wastewater can be released to a subsurface drain field. The solids from the septic tanks are pumped out or removed for off-site disposal (e.g., at a landfill).